# Visualizations of Network Statistics Over Time Using Vertex Bootstrap and Jackknife

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This document contains visualizations showing distributions of the differences in several network statistics over time. The distributions are obtained using the vertex bootstrap and jackknife procedures. Two different temporal networks are examined.

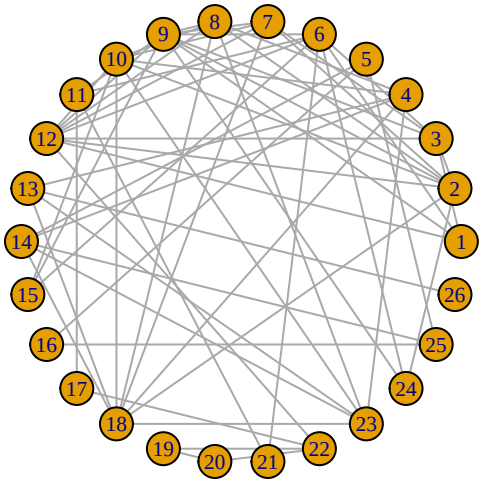
Source code (to generate distributions): https://github.com/alansun25/network-analysis/blob/main/analysis/vert-jack-viz.R

## Friendship in a Dutch school class

Data source:

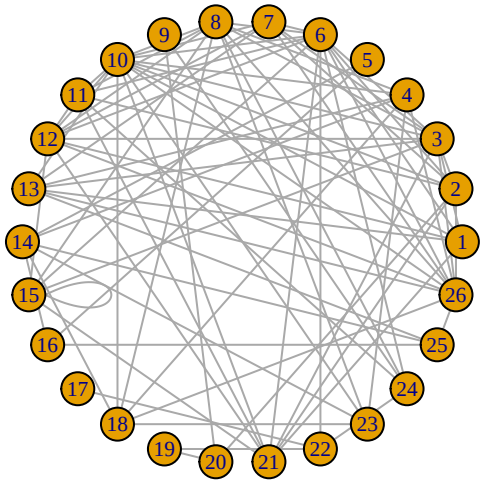
- **RSiena**
- Andrea Knecht
- https://www.stats.ox.ac.uk/~snijders/siena/tutorial2010_data.htm
- 2008

### Original Friendship Networks



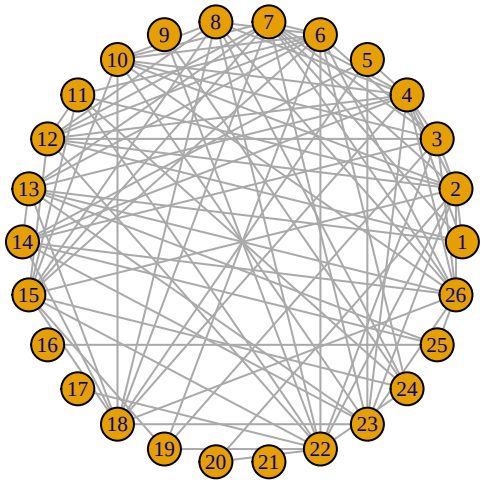

Transitivity: 0.5076923, Mean Degree: 4.8461538, Edge Density: 0.1938462, Number of nodes in a k-core where k $>$ 1: 25

## Friendships at time 2 (Three months after time 1)



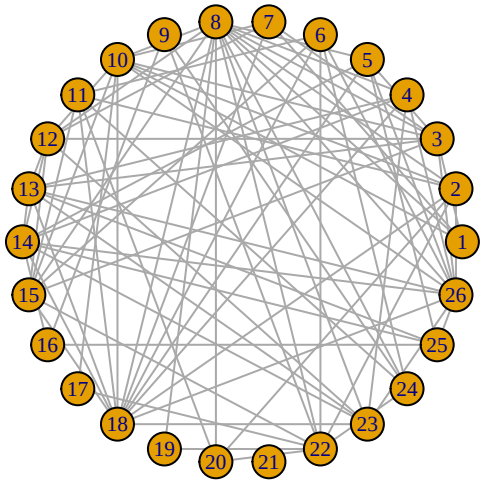

Transitivity: 0.5609756, Mean Degree: 6.5384615, Edge Density: 0.2615385, Number of nodes in a k-core where k > 1: 25

## Friendships at time 3 (Three months after time 2)



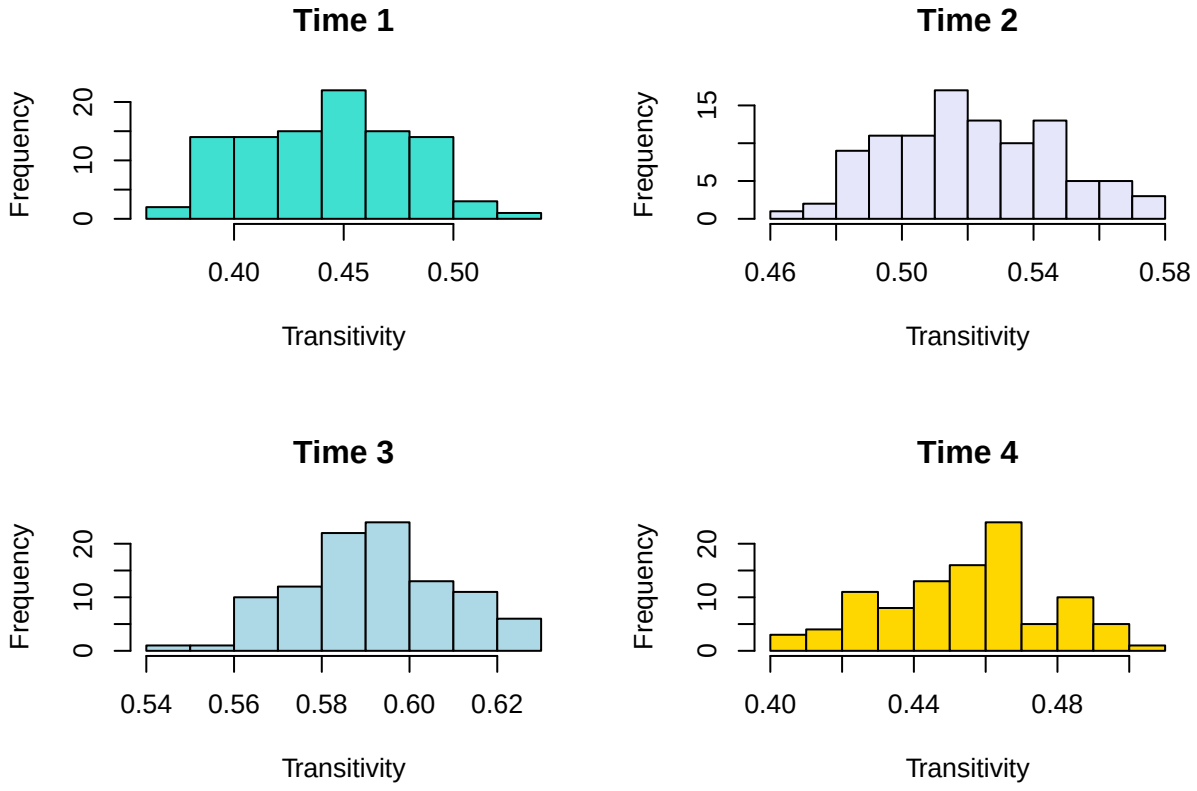

Transitivity: 0.5542312, Mean Degree: 7.4615385, Edge Density: 0.2984615, Number of nodes in a k-core where k > 1: 23

## Friendships at time 4 (Three months after time 3)

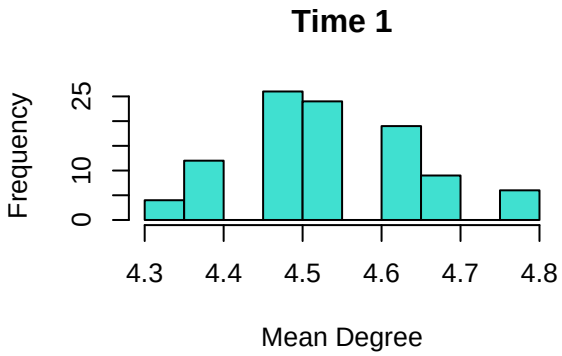


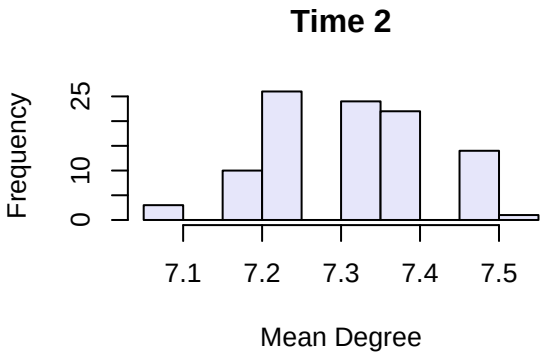

Transitivity: 0.4467085, Mean Degree: 6.6153846, Edge Density: 0.2646154, Number of nodes in a k-core where k > 1: 25

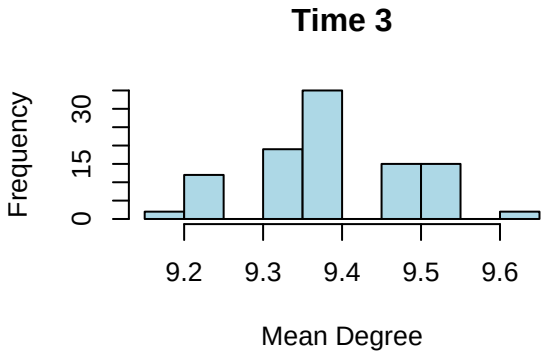
### Vertex Bootstrapped Distributions of Network Statistics

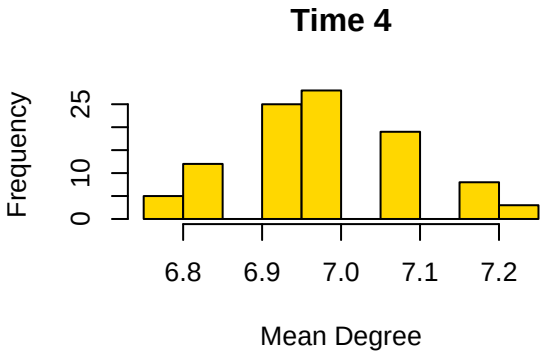



Transitivity:

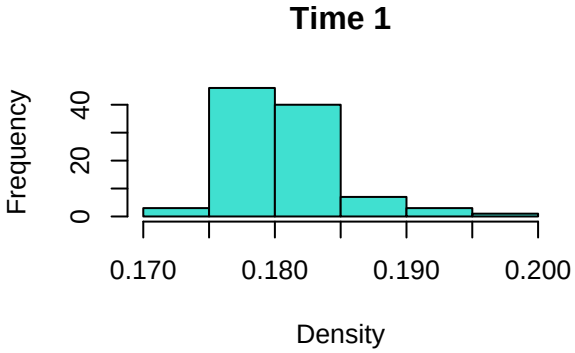


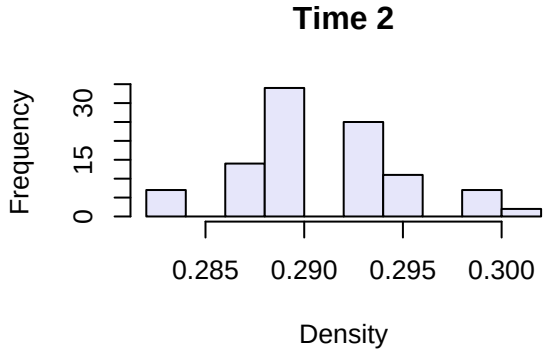



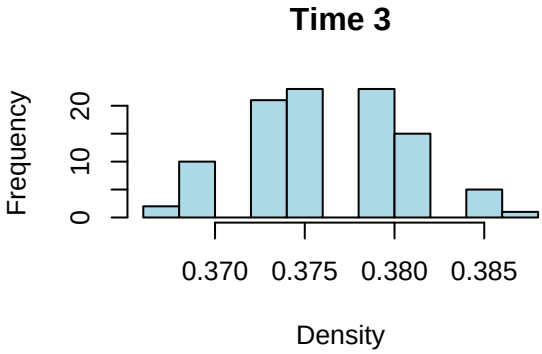



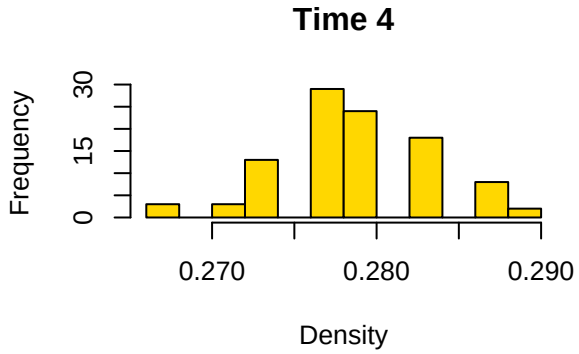




Mean Degree:

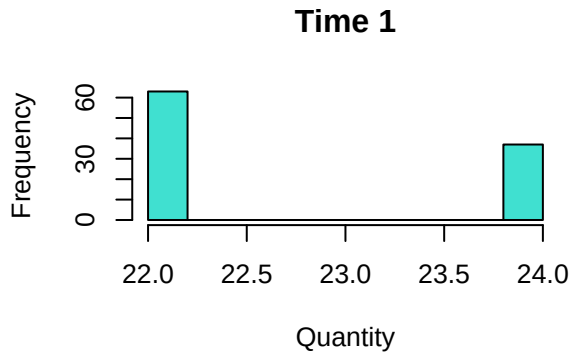


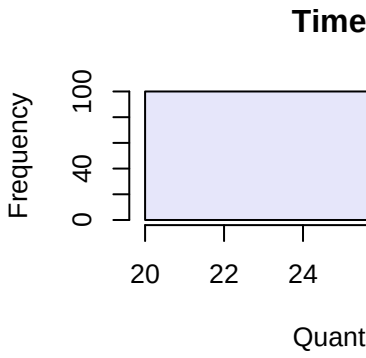



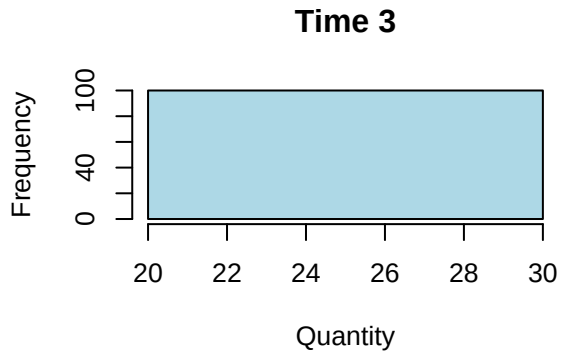



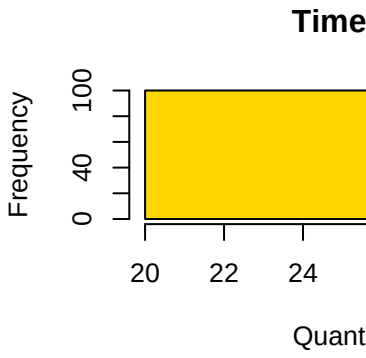




Edge Density:



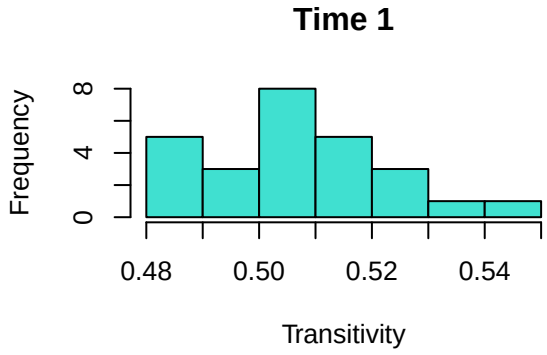



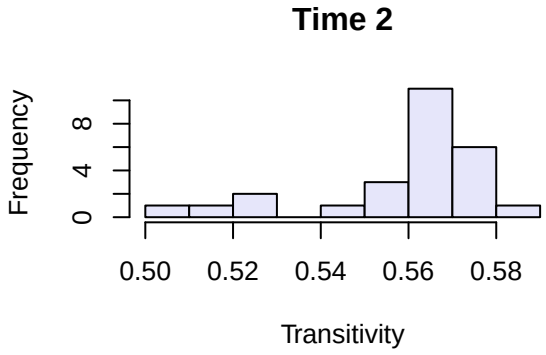



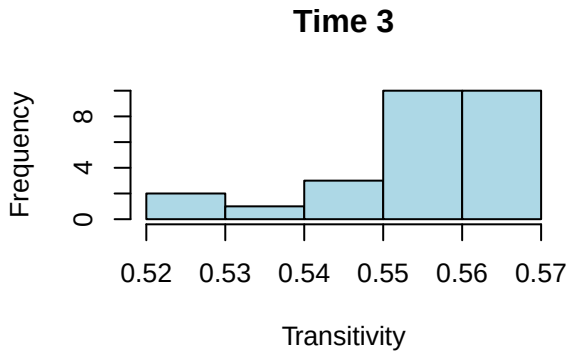



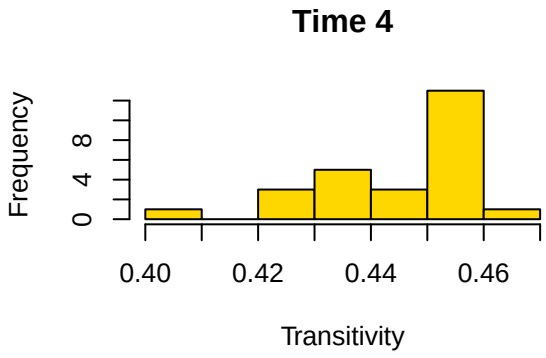

Number of nodes in k-cores where k > 1:

## Vertex Jackknife Distributions of Network Statistics

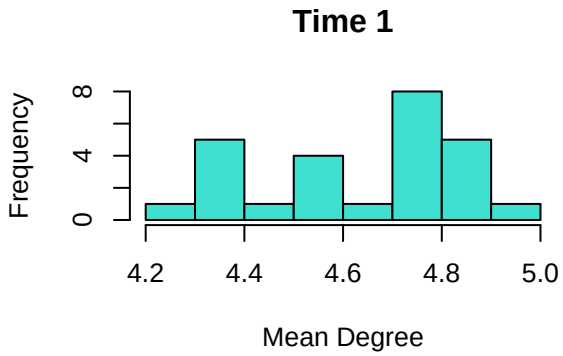


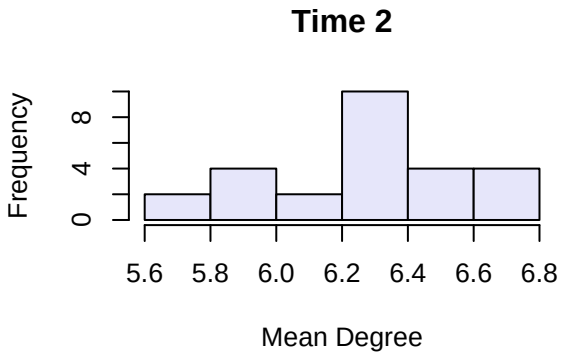



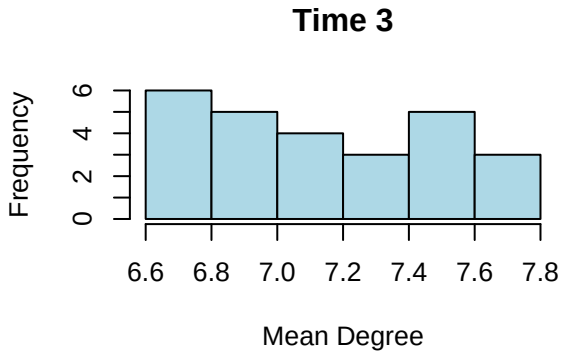



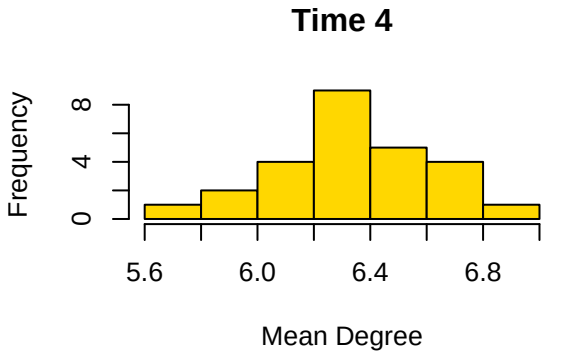




Transitivity:

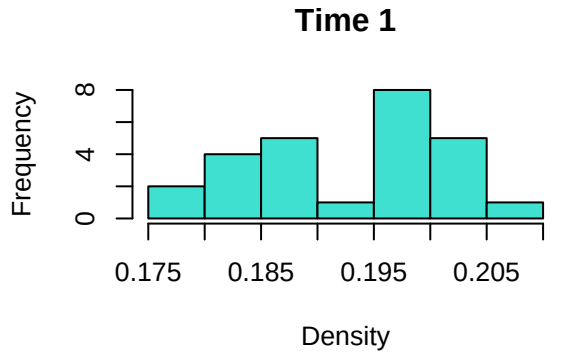


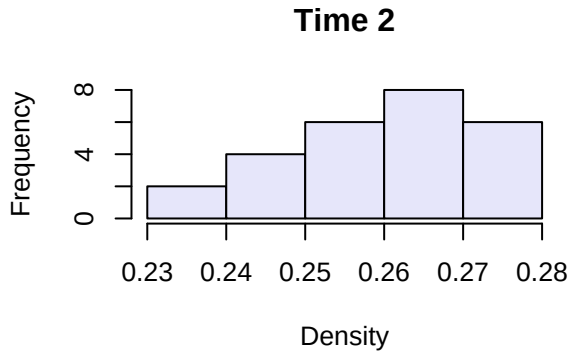



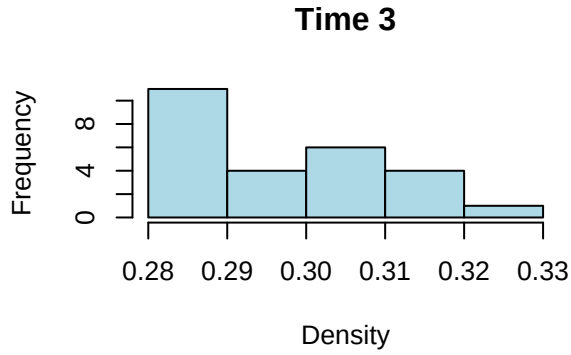



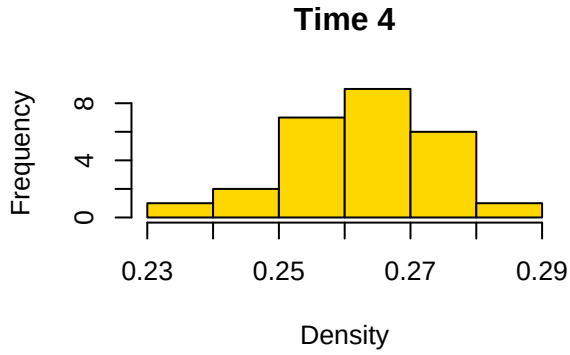




Mean Degree:

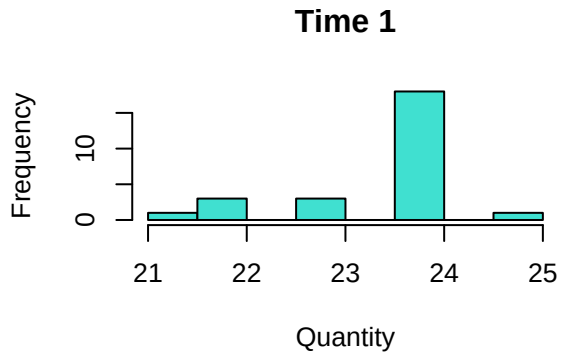


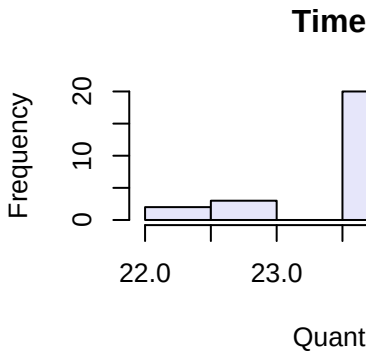



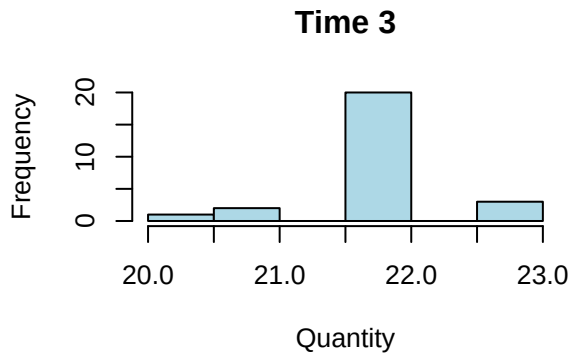



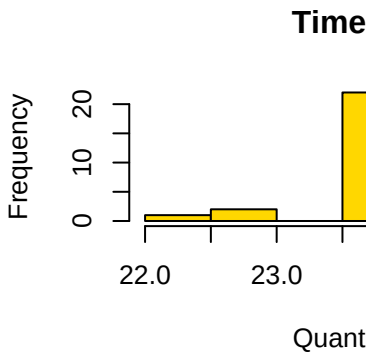




Edge Density:



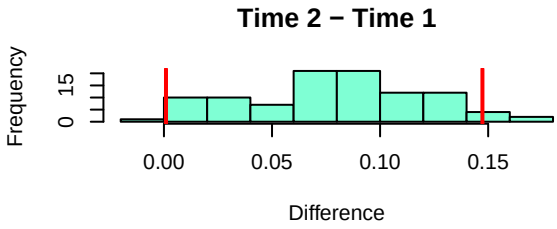



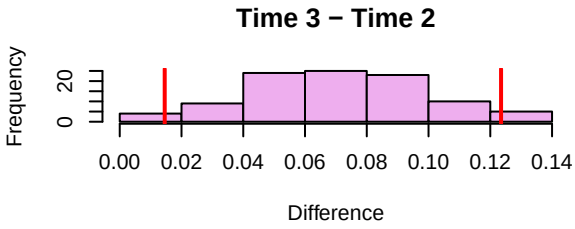



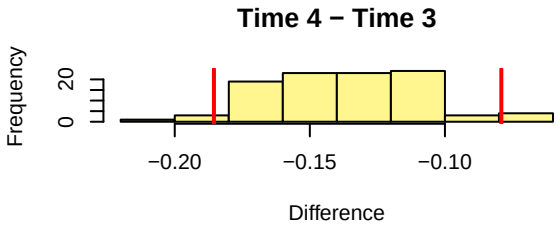

Number of nodes in k-cores where k $> 1$:

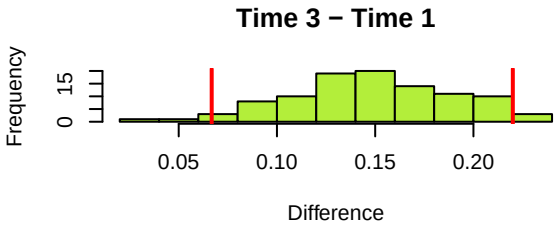
## Bootstrap distributions of the differences in network statistics between time points

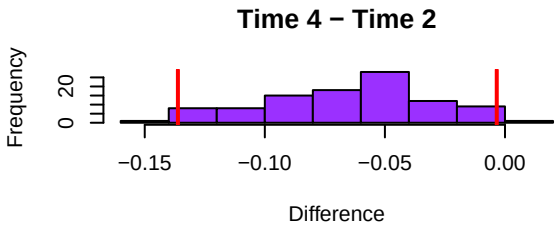
**The vertical red lines indicate the middle 95% of the distributions.**

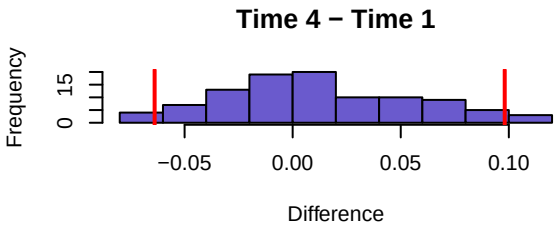


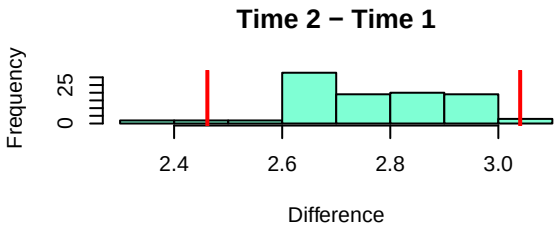



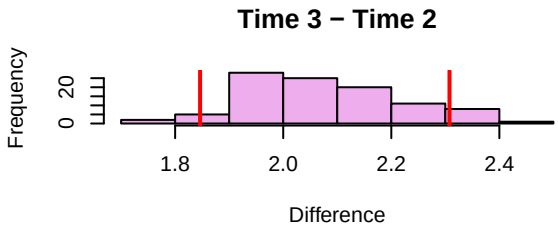



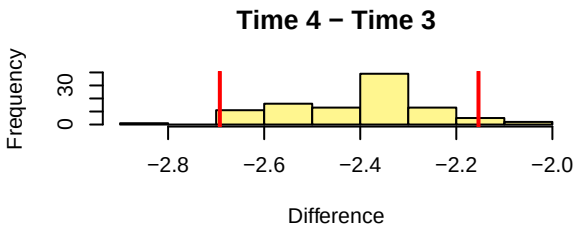



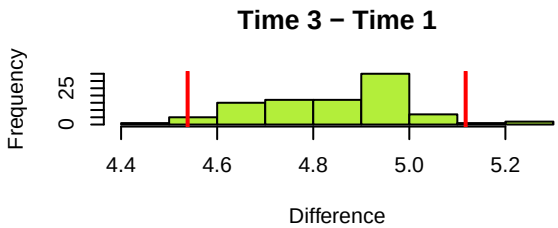



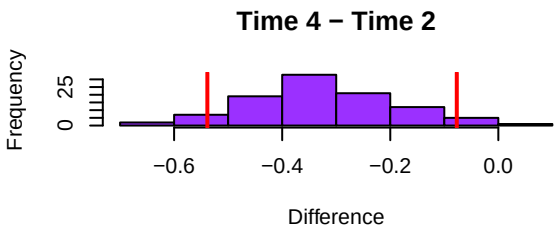

Transitivity:

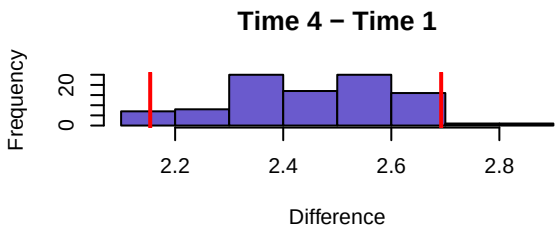


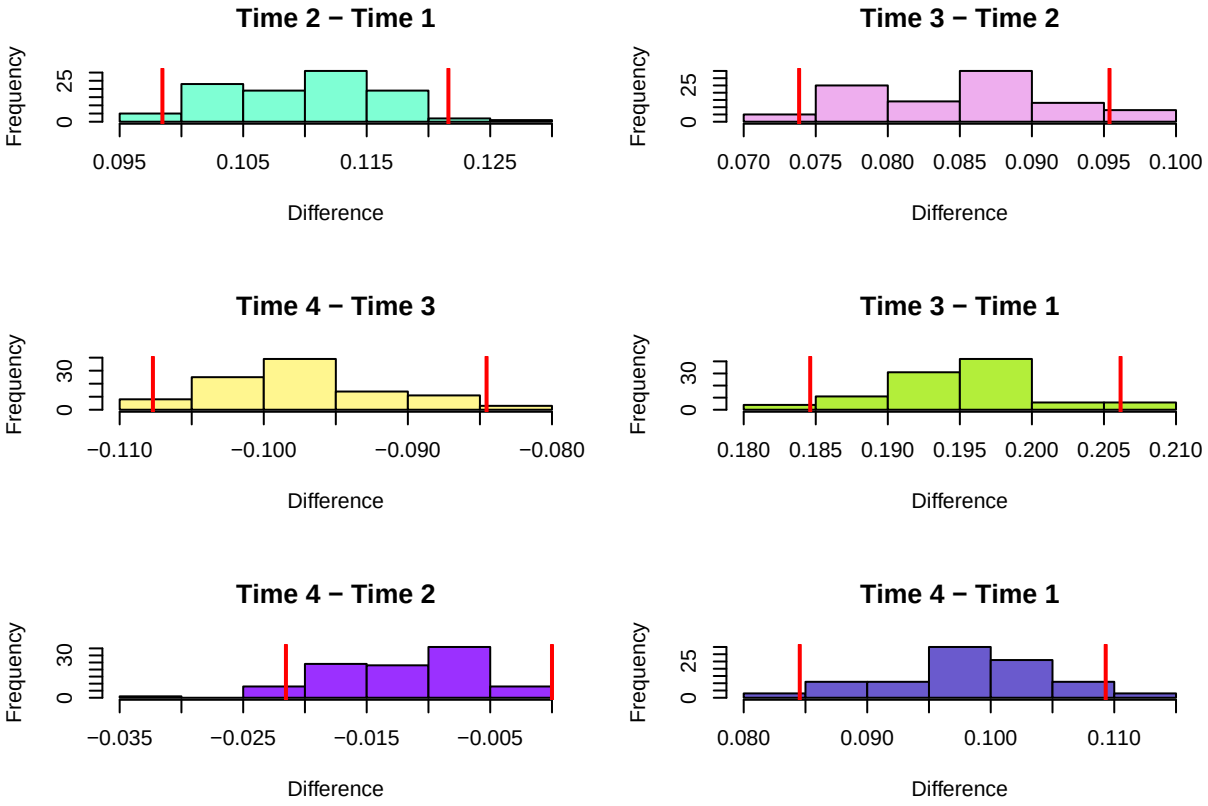



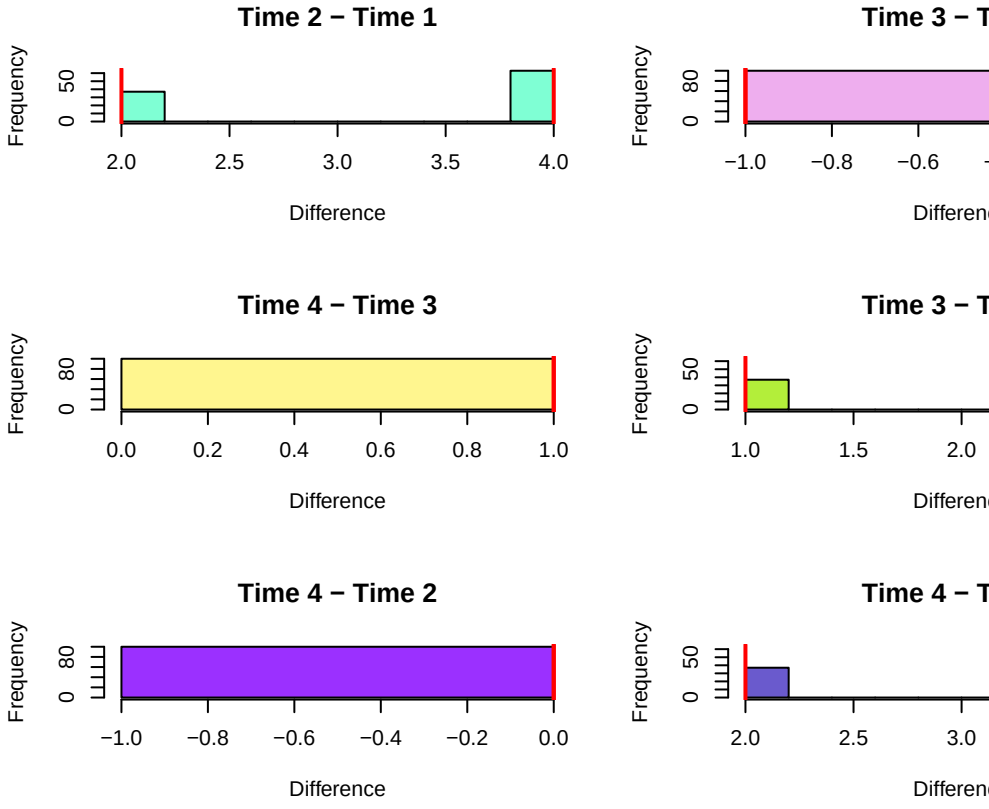




Mean Degree:



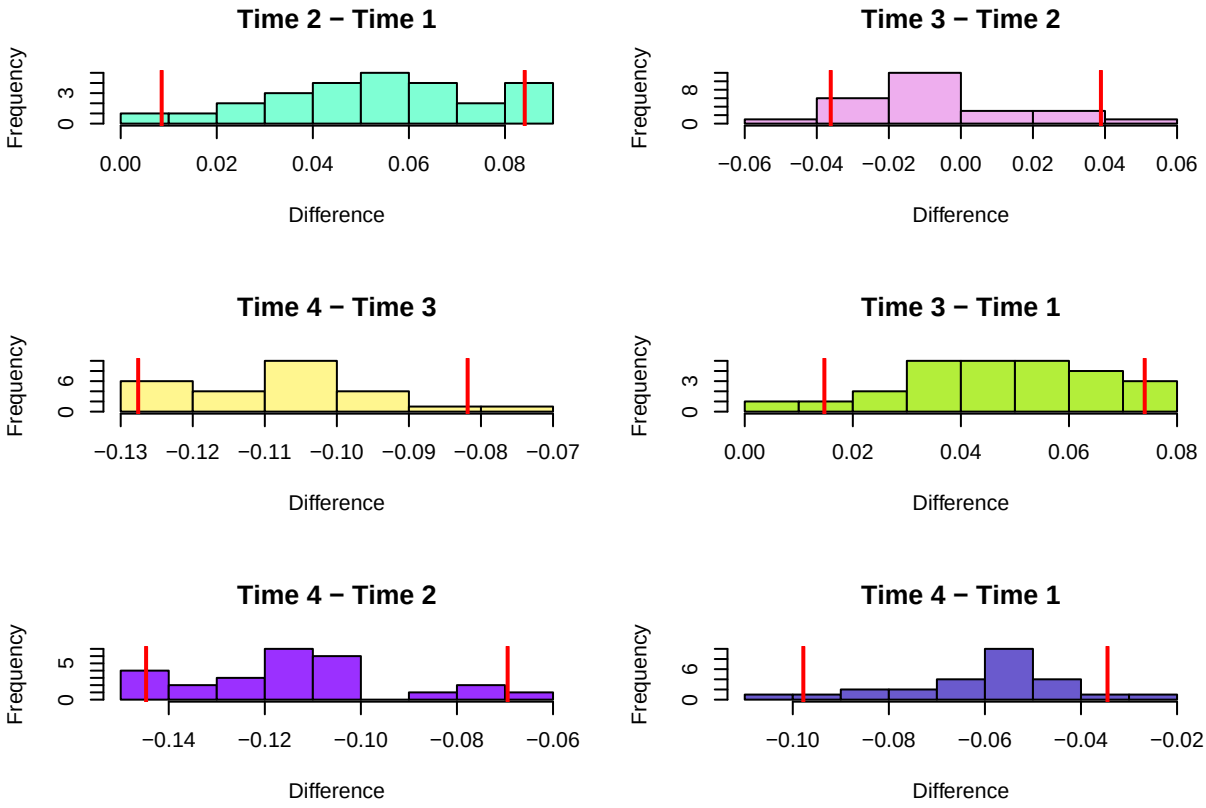

Edge Density:



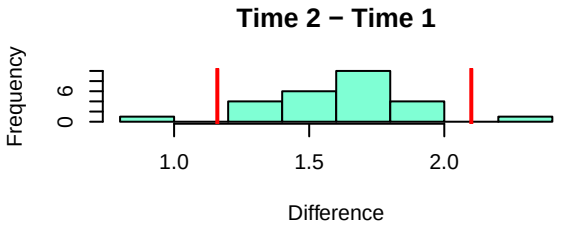

Number of nodes in k-cores where k $>$ 1:

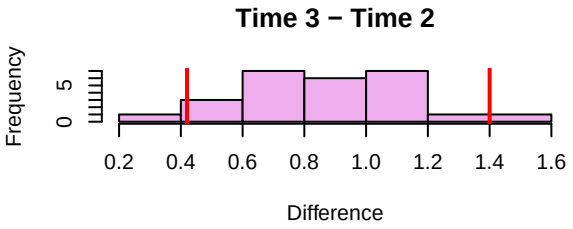
## Jackknife distributions of the differences in network statistics between time points

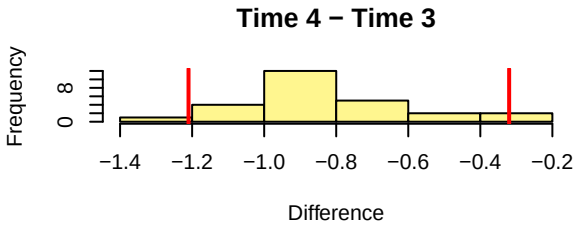
**The vertical red lines indicate the middle 95% of the distributions.**

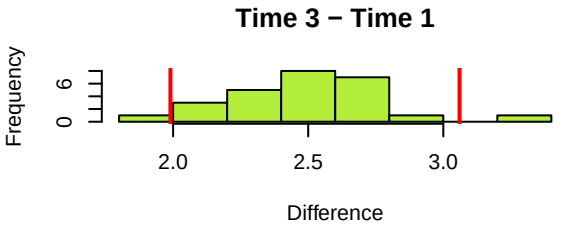


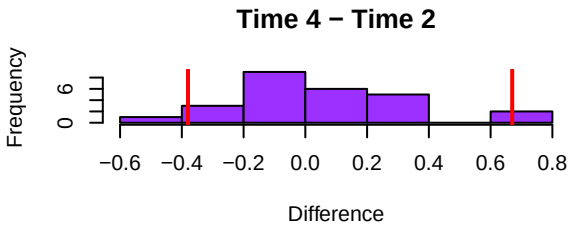

Transitivity:

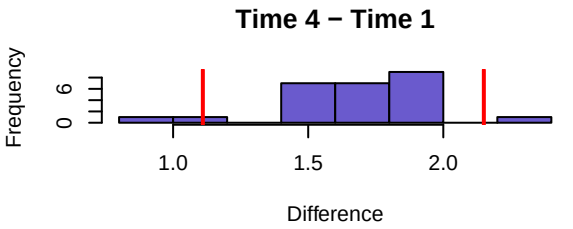


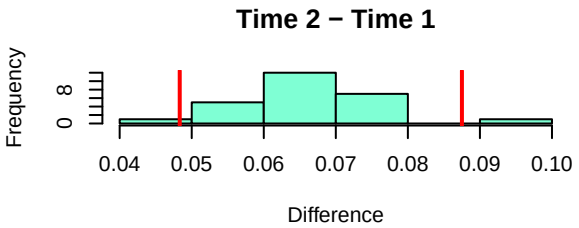



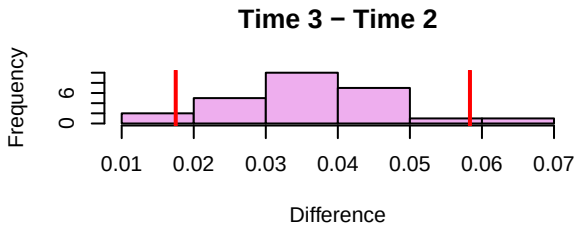



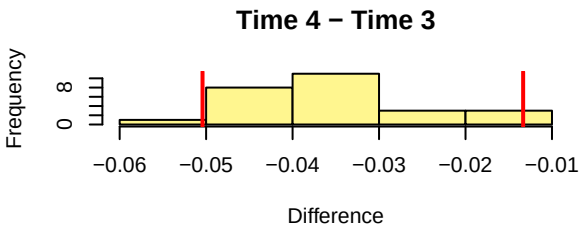



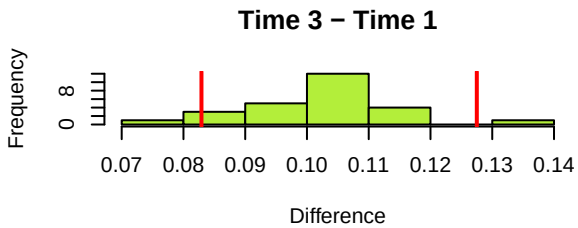



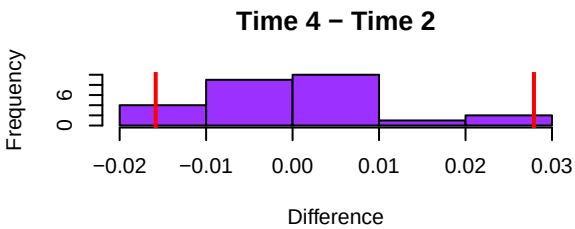

Mean Degree:

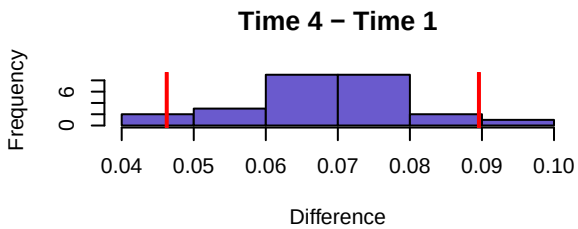


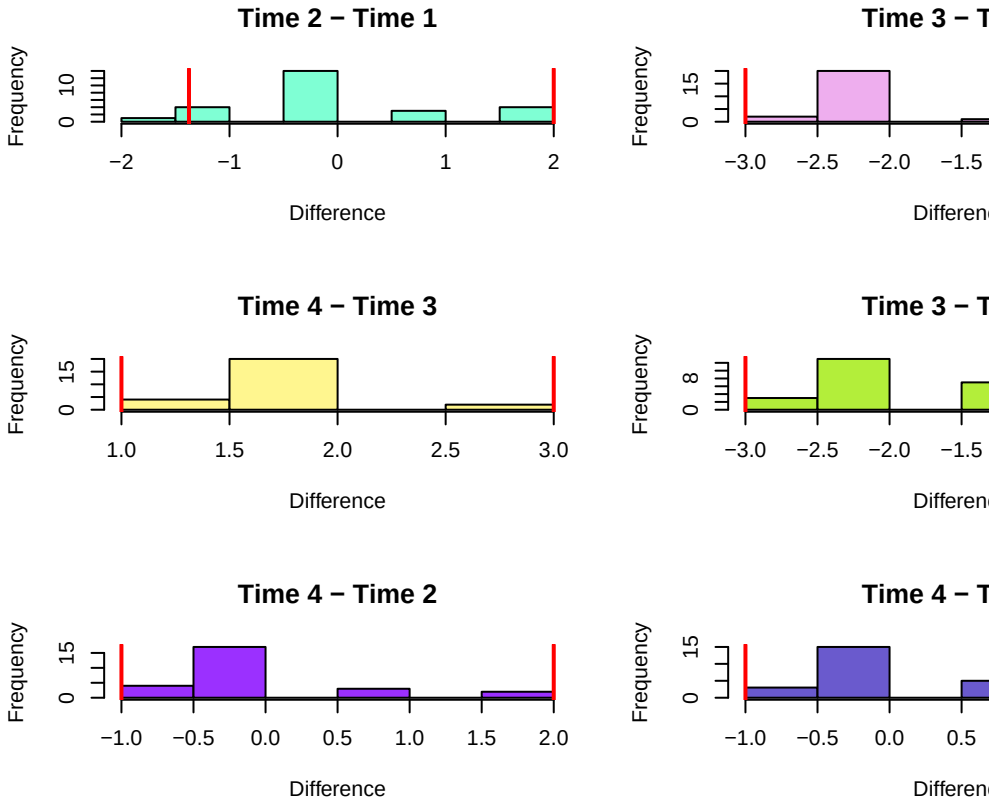




Edge Density:




Number of nodes in k-cores where k > 1:

**If we assume that the distributions are normal, do we see significance in the same places?**

**Bootstrap distributions:**

Transitivity:

```
##
##  Paired t-test
##
## data:  tboot_f2 and tboot_f1
## t = 18.827, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.07055640 0.08718046
## sample estimates:
## mean of the differences
##              0.07886843
```

```
##
##  Paired t-test
##
## data:  tboot_f3 and tboot_f2
## t = 24.69, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.06425043 0.07547988
## sample estimates:
## mean of the differences
##              0.06986516
```

```
##
##  Paired t-test
##
## data:  tboot_f4 and tboot_f3
## t = -49.526, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1417577 -0.1308365
## sample estimates:
## mean of the differences
##              -0.1362971
```

```
##
##  Paired t-test
##
## data:  tboot_f3 and tboot_f1
## t = 36.793, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.1407125 0.1567547
## sample estimates:
## mean of the differences
##               0.1487336
```

```
##
##  Paired t-test
##
## data:  tboot_f4 and tboot_f2
## t = -18.753, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.07346084 -0.05940305
## sample estimates:
## mean of the differences
##             -0.06643195
```

```
##
##  Paired t-test
##
## data:  tboot_f4 and tboot_f1
## t = 2.8452, df = 99, p-value = 0.005395
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.003763305 0.021109669
## sample estimates:
## mean of the differences
##              0.01243649
```

Mean Degree:

```
##
##  Paired t-test
##
## data:  mdboot_f2 and mdboot_f1
## t = 192.07, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
```

```
## 95 percent confidence interval:
##  2.744430 2.801724
## sample estimates:
## mean of the differences
##                2.773077

##
##  Paired t-test
##
## data:  mdboot_f3 and mdboot_f2
## t = 149.51, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  2.052395 2.107605
## sample estimates:
## mean of the differences
##                    2.08

##
##  Paired t-test
##
## data:  mdboot_f4 and mdboot_f3
## t = -159.11, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -2.431487 -2.371589
## sample estimates:
## mean of the differences
##               -2.401538

##
##  Paired t-test
##
## data:  mdboot_f3 and mdboot_f1
## t = 313.01, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  4.822313 4.883841
## sample estimates:
## mean of the differences
##                4.853077

##
##  Paired t-test
##
## data:  mdboot_f4 and mdboot_f2
## t = -23.15, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.3490978 -0.2939792
## sample estimates:
## mean of the differences
##              -0.3215385

##
##  Paired t-test
```

```
##
## data:  mdboot_f4 and mdboot_f1
## t = 158.69, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  2.420885 2.482192
## sample estimates:
## mean of the differences
##                2.451538
```

Edge Density:

```
##
##  Paired t-test
##
## data:  dboot_f2 and dboot_f1
## t = 180.93, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.1088850 0.1112997
## sample estimates:
## mean of the differences
##               0.1100923
```

```
##
##  Paired t-test
##
## data:  dboot_f3 and dboot_f2
## t = 140.69, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.08424107 0.08665124
## sample estimates:
## mean of the differences
##              0.08544615
```

```
##
##  Paired t-test
##
## data:  dboot_f4 and dboot_f3
## t = -155.37, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.09850367 -0.09601940
## sample estimates:
## mean of the differences
##             -0.09726154
```

```
##
##  Paired t-test
##
## data:  dboot_f3 and dboot_f1
## t = 346.64, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.1944192 0.1966578
```

```
## sample estimates:
## mean of the differences
##               0.1955385
```

```
##
##  Paired t-test
##
## data:  dboot_f4 and dboot_f2
## t = -20.738, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.01294588 -0.01068489
## sample estimates:
## mean of the differences
##             -0.01181538
```

```
##
##  Paired t-test
##
## data:  dboot_f4 and dboot_f1
## t = 145.11, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.09693309 0.09962076
## sample estimates:
## mean of the differences
##              0.09827692
```

Number of nodes in k-cores where k $>$ 1:

*Data are essentially constant.*

**Jackknife distributions:**

Transitivity:

```
##
##  Paired t-test
##
## data:  tjack_f2 and tjack_f1
## t = 12.633, df = 25, p-value = 2.367e-12
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.04406672 0.06123334
## sample estimates:
## mean of the differences
##              0.05265003
```

```
##
##  Paired t-test
##
## data:  tjack_f3 and tjack_f2
## t = -1.4429, df = 25, p-value = 0.1615
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.014285086  0.002515222
## sample estimates:
## mean of the differences
```

```
##           -0.005884932
##
##  Paired t-test
##
## data:  tjack_f4 and tjack_f3
## t = -42.731, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1128502 -0.1024720
## sample estimates:
## mean of the differences
##             -0.1076611
##
##  Paired t-test
##
## data:  tjack_f3 and tjack_f1
## t = 13.553, df = 25, p-value = 5.066e-13
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.03965868 0.05387152
## sample estimates:
## mean of the differences
##              0.0467651
##
##  Paired t-test
##
## data:  tjack_f4 and tjack_f2
## t = -26.577, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1223449 -0.1047471
## sample estimates:
## mean of the differences
##              -0.113546
##
##  Paired t-test
##
## data:  tjack_f4 and tjack_f1
## t = -18.075, df = 25, p-value = 7.252e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.06783477 -0.05395722
## sample estimates:
## mean of the differences
##             -0.06089599
```

Mean Degree:

```
##
##  Paired t-test
##
## data:  mdjack_f2 and mdjack_f1
## t = 31.006, df = 25, p-value < 2.2e-16
```

```
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.519576 1.735809
## sample estimates:
## mean of the differences
##                1.627692

##
##  Paired t-test
##
## data:  mdjack_f3 and mdjack_f2
## t = 16.671, df = 25, p-value = 4.713e-15
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.7739841 0.9921698
## sample estimates:
## mean of the differences
##               0.8830769

##
##  Paired t-test
##
## data:  mdjack_f4 and mdjack_f3
## t = -16.873, df = 25, p-value = 3.572e-15
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.9114576 -0.7131578
## sample estimates:
## mean of the differences
##              -0.8123077

##
##  Paired t-test
##
## data:  mdjack_f3 and mdjack_f1
## t = 42.761, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  2.389840 2.631699
## sample estimates:
## mean of the differences
##                2.510769

##
##  Paired t-test
##
## data:  mdjack_f4 and mdjack_f2
## t = 1.3559, df = 25, p-value = 0.1872
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.03672164  0.17826010
## sample estimates:
## mean of the differences
##              0.07076923

##
```

```
##  Paired t-test
##
## data:  mdjack_f4 and mdjack_f1
## t = 30.712, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.584564 1.812359
## sample estimates:
## mean of the differences
##               1.698462
```

Edge Density:

```
##
##  Paired t-test
##
## data:  djack_f2 and djack_f1
## t = 31.006, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.06331565 0.07232537
## sample estimates:
## mean of the differences
##              0.06782051
```

```
##
##  Paired t-test
##
## data:  djack_f3 and djack_f2
## t = 16.671, df = 25, p-value = 4.713e-15
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.03224934 0.04134041
## sample estimates:
## mean of the differences
##              0.03679487
```

```
##
##  Paired t-test
##
## data:  djack_f4 and djack_f3
## t = -16.873, df = 25, p-value = 3.572e-15
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.03797740 -0.02971491
## sample estimates:
## mean of the differences
##             -0.03384615
```

```
##
##  Paired t-test
##
## data:  djack_f3 and djack_f1
## t = 42.761, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
```

```
##  0.09957665 0.10965412
## sample estimates:
## mean of the differences
##               0.1046154
```

```
##
##  Paired t-test
##
## data:  djack_f4 and djack_f2
## t = 1.3559, df = 25, p-value = 0.1872
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.001530068  0.007427504
## sample estimates:
## mean of the differences
##             0.002948718
```

```
##
##  Paired t-test
##
## data:  djack_f4 and djack_f1
## t = 30.712, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.06602350 0.07551497
## sample estimates:
## mean of the differences
##              0.07076923
```

Number of nodes in k-cores where k $>$ 1:

```
##
##  Paired t-test
##
## data:  kjack_f2 and kjack_f1
## t = 0.96083, df = 25, p-value = 0.3458
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.2199046  0.6045200
## sample estimates:
## mean of the differences
##               0.1923077
```

```
##
##  Paired t-test
##
## data:  kjack_f3 and kjack_f2
## t = -12.3, df = 25, p-value = 4.22e-12
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -2.110365 -1.505020
## sample estimates:
## mean of the differences
##               -1.807692
```

```
##
##  Paired t-test
```

```
##
## data:  kjack_f4 and kjack_f3
## t = 20.278, df = 25, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  1.727756 2.118398
## sample estimates:
## mean of the differences
##                1.923077
```

```
##
##  Paired t-test
##
## data:  kjack_f3 and kjack_f1
## t = -9.666, df = 25, p-value = 6.336e-10
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1.959574 -1.271195
## sample estimates:
## mean of the differences
##               -1.615385
```

```
##
##  Paired t-test
##
## data:  kjack_f4 and kjack_f2
## t = 0.76847, df = 25, p-value = 0.4494
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1938507  0.4246199
## sample estimates:
## mean of the differences
##               0.1153846
```

```
##
##  Paired t-test
##
## data:  kjack_f4 and kjack_f1
## t = 1.8732, df = 25, p-value = 0.07278
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.03061314  0.64599776
## sample estimates:
## mean of the differences
##               0.3076923
```

# Tortoise Interactions

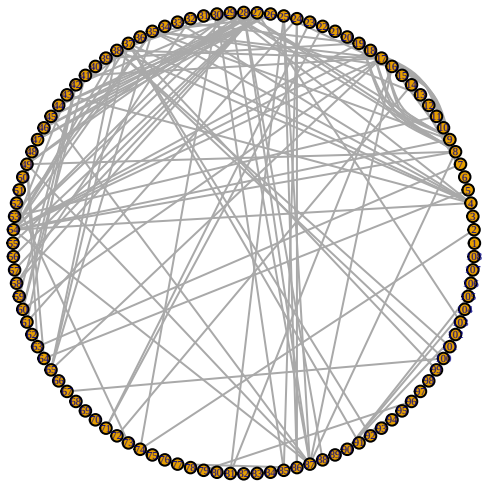
Data source:

- **The Network Data Repository with Interactive Graph Analytics and Visualization**
- Ryan A. Rossi and Nesreen K. Ahmed
- *AAAI*
- http://networkrepository.com/
- 2015

### Original Tortoise Networks

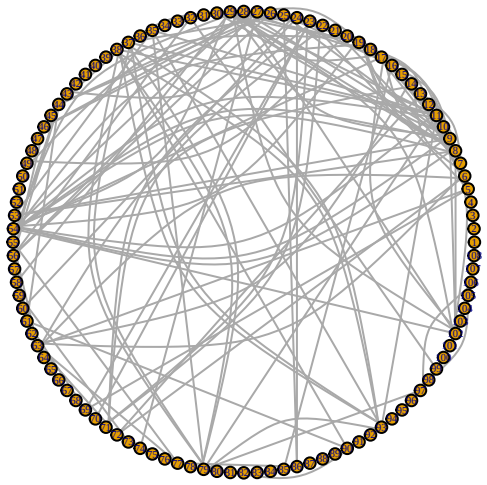
**Note: I omitted the network data from the year 1996 because there were only 7 data points, and because I reduced each network to only contain the intersection of nodes, using 1996 would have resulted in too few tortoises.**

## Tortoise interactions in 1997



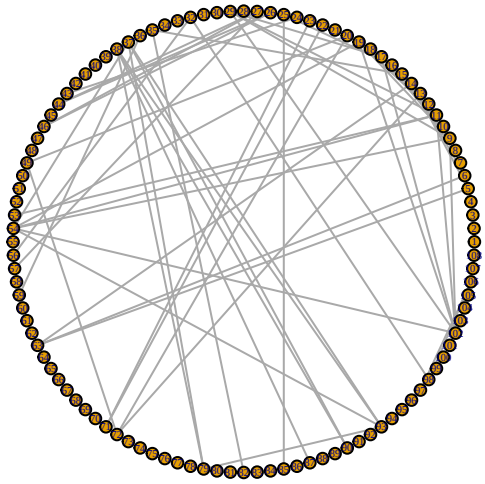
Transitivity: 0.4131148, Mean Degree: 3.7962963, Edge Density: 0.0354794, Number of nodes in a k-core where k > 1: 81

## Tortoise interactions in 1998



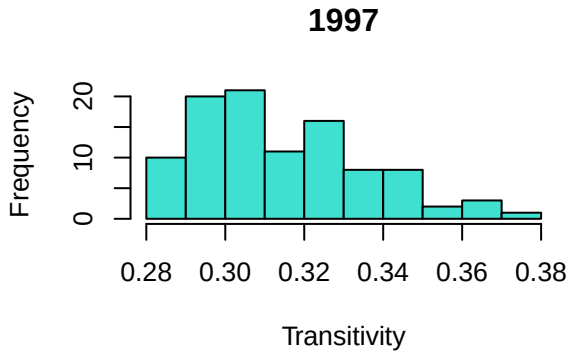
Transitivity: 0.533101, Mean Degree: 2.7962963, Edge Density: 0.0261336, Number of nodes in a k-core where k > 1: 45

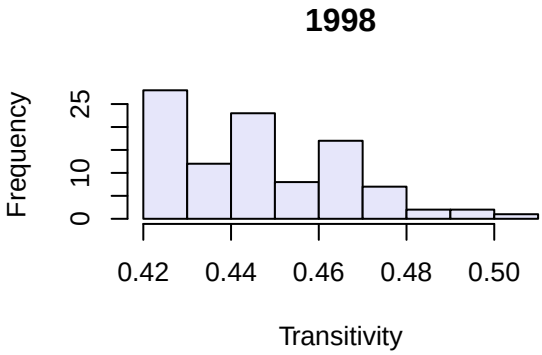
## Tortoise interactions in 1999

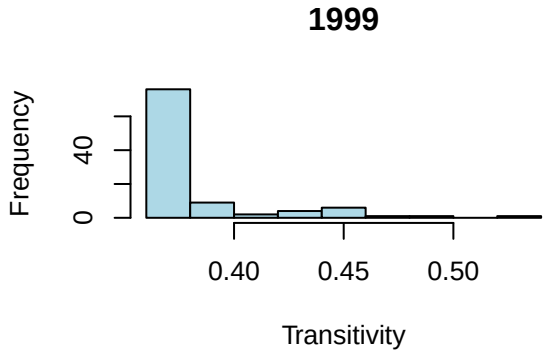


Transitivity: 0.6325301, Mean Degree: 1.1666667, Edge Density: 0.0109034, Number of nodes in a k-core where k > 1: 27

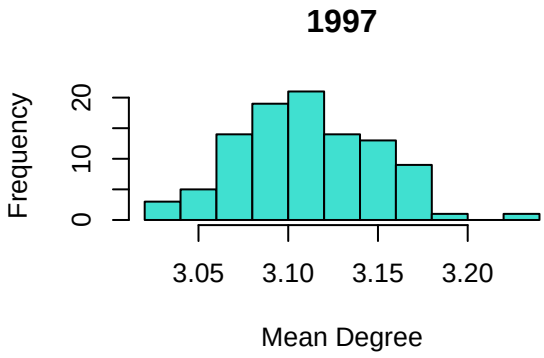
### Vertex Bootstrapped Distributions of Network Statistics

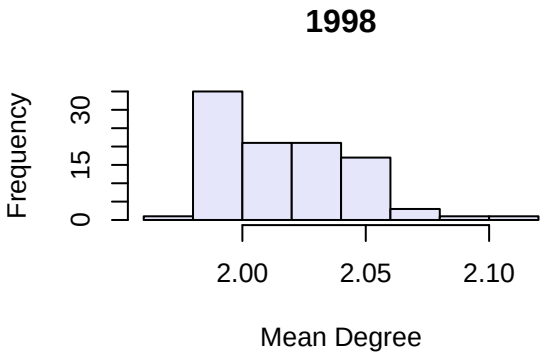


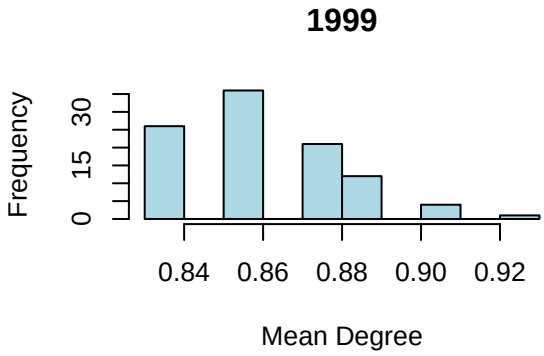



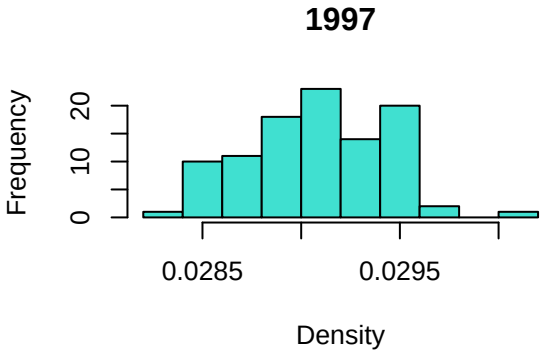

Transitivity:

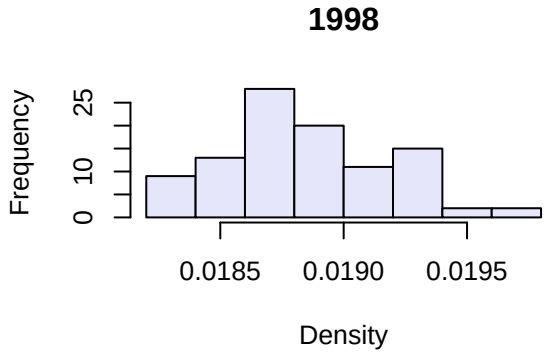


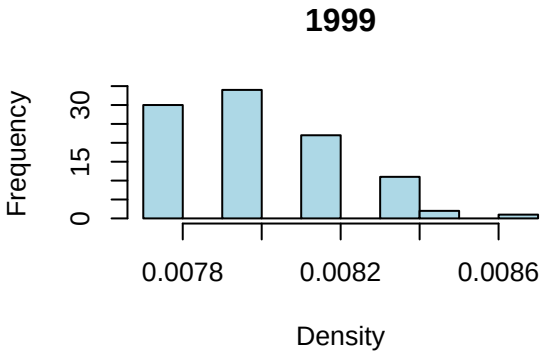



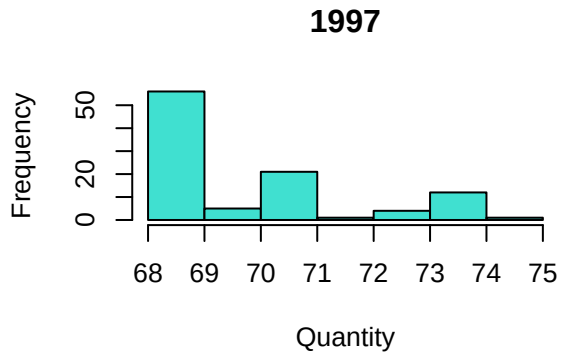

Mean Degree:

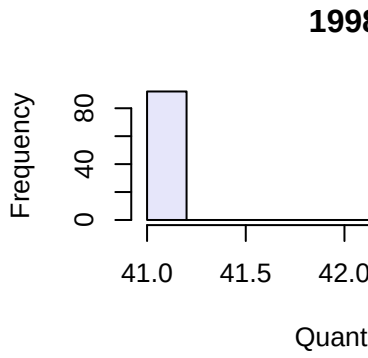


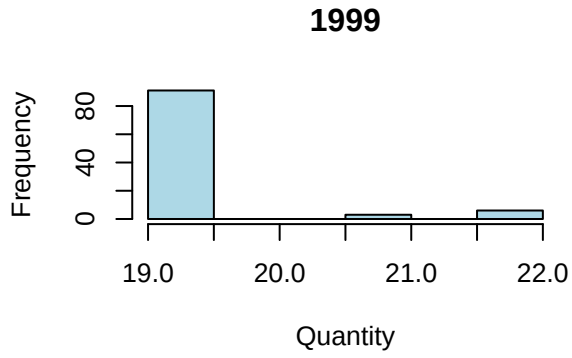




Edge Density:

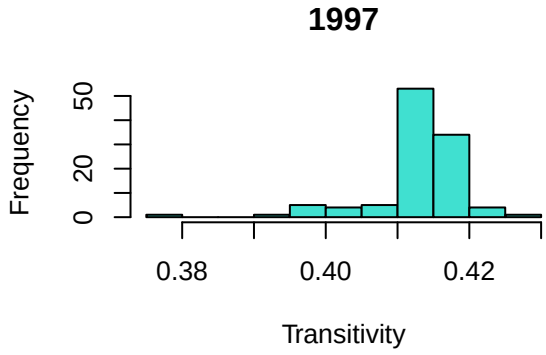


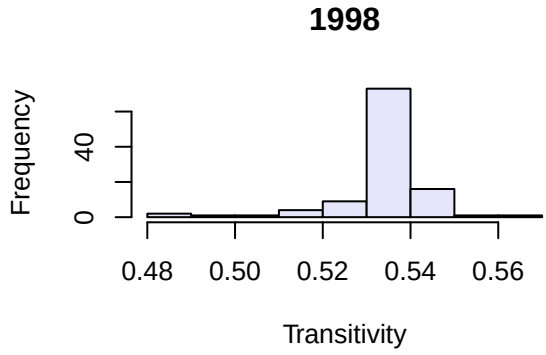



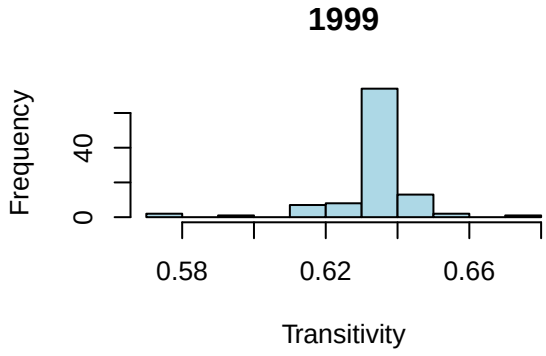




Number of nodes in k-cores where k > 1:

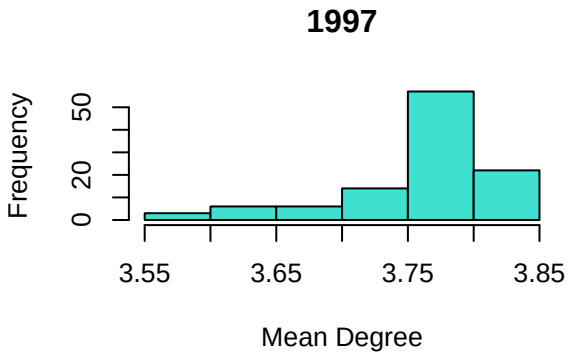
## Vertex Jackknife Distributions of Network Statistics

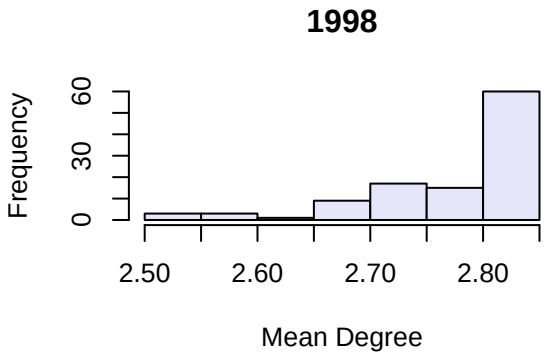


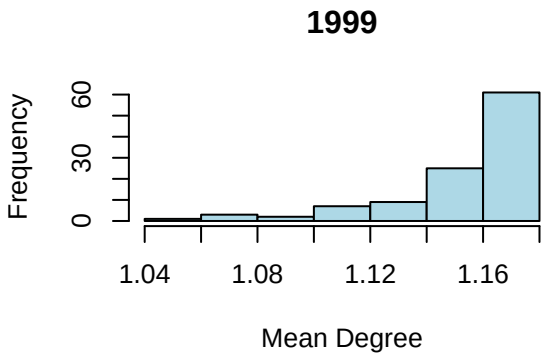



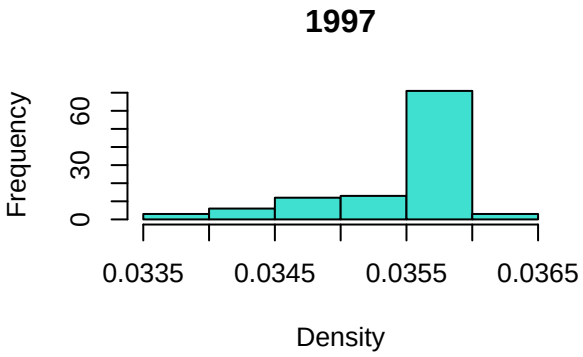

Transitivity:

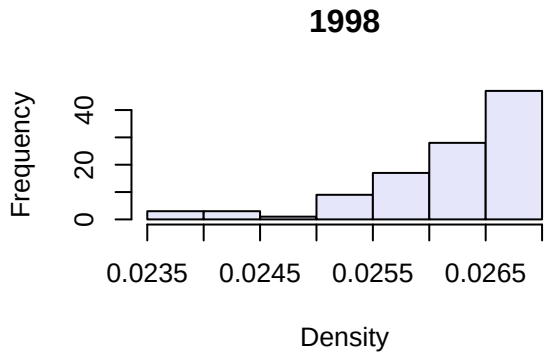


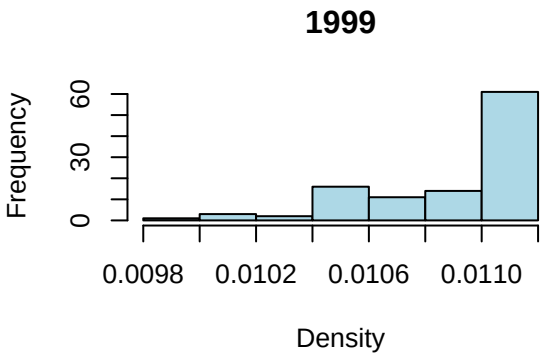



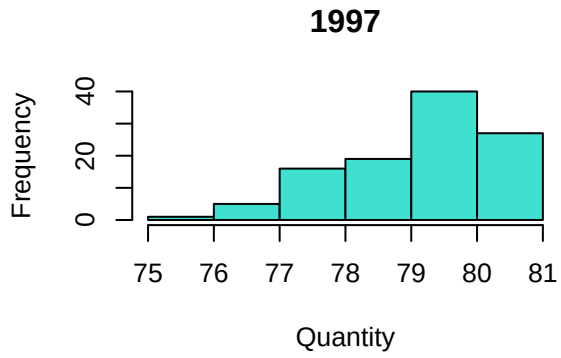

Mean Degree:

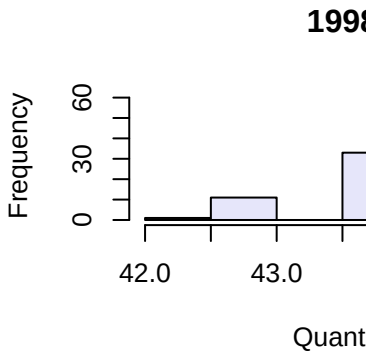


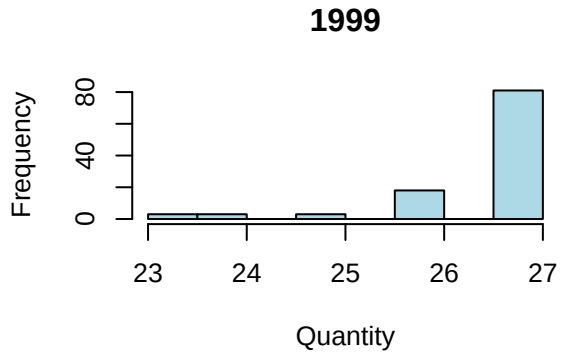




Edge Density:



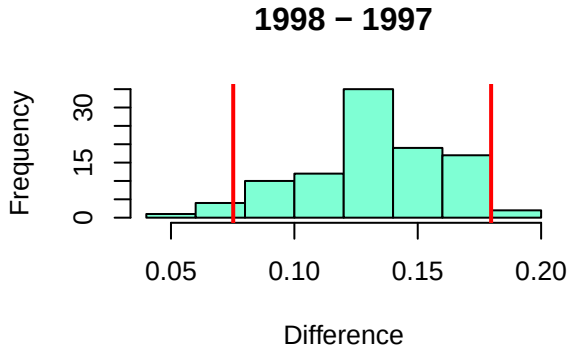



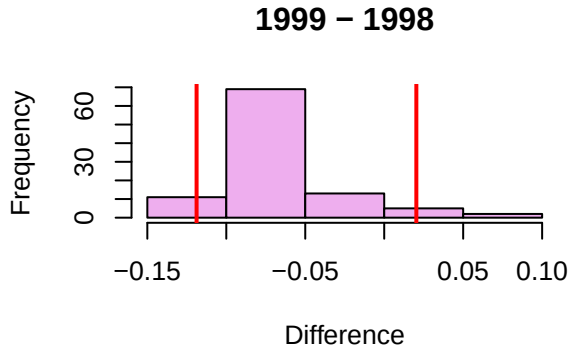



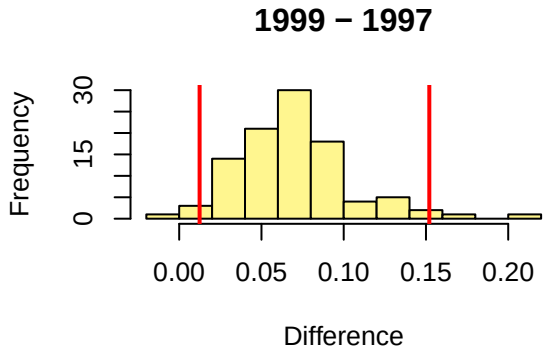

Number of nodes in k-cores where k > 1:

## Bootstrap distributions of the differences in network statistics between time points

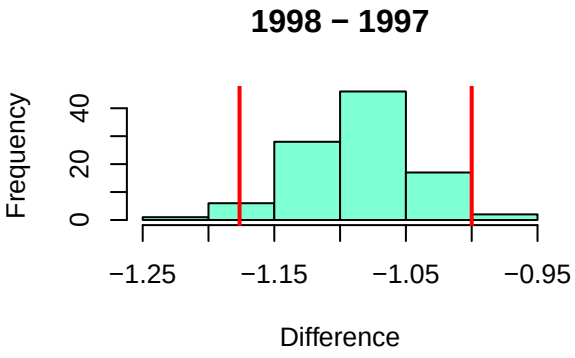
**The vertical red lines indicate the middle 95% of the distributions.**

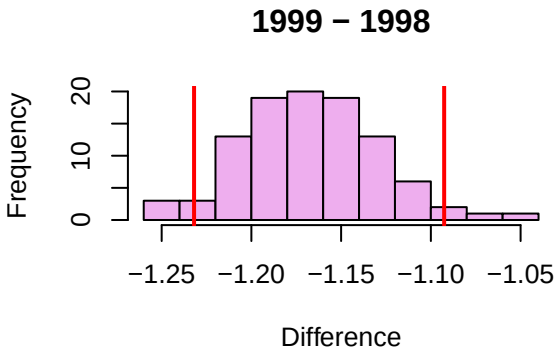


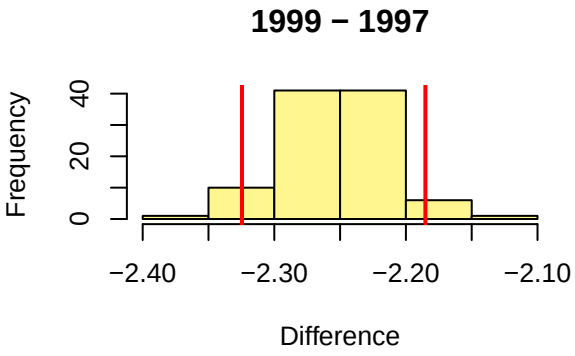



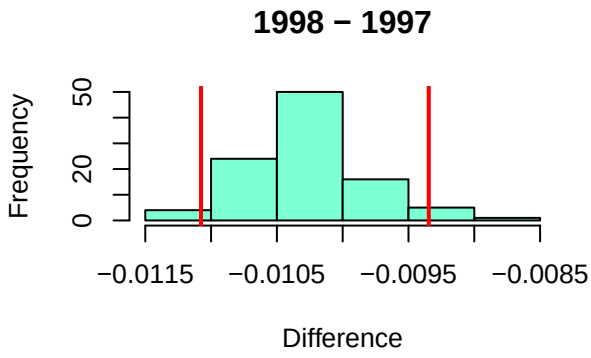

Transitivity:

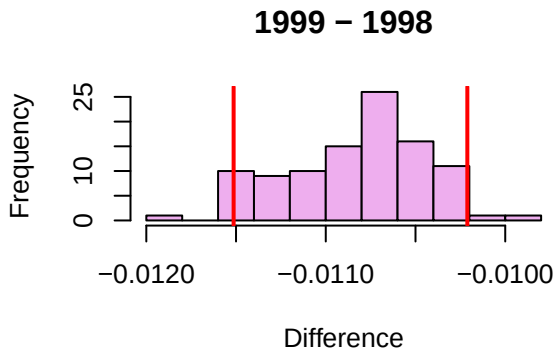


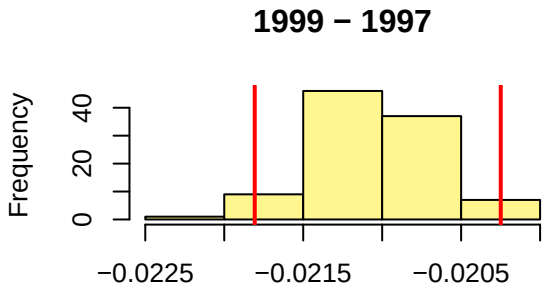



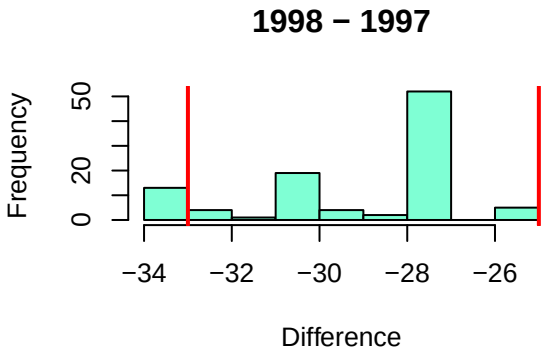

Mean Degree:

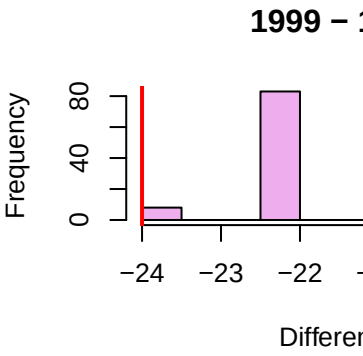


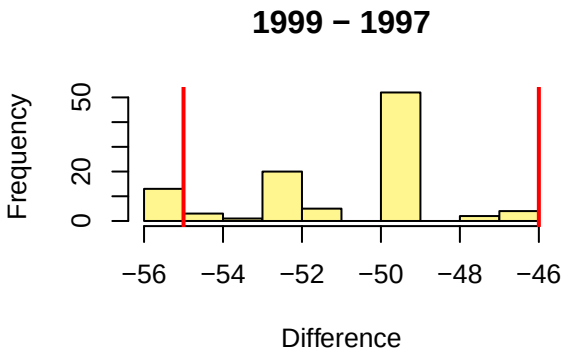




Edge Density:



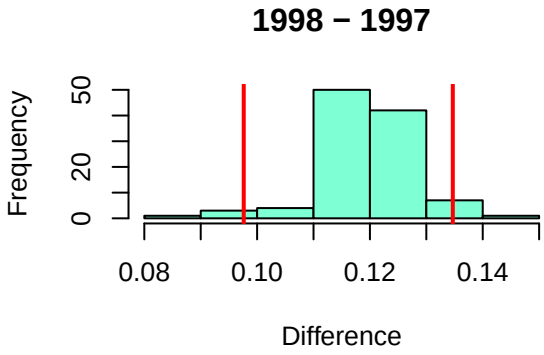



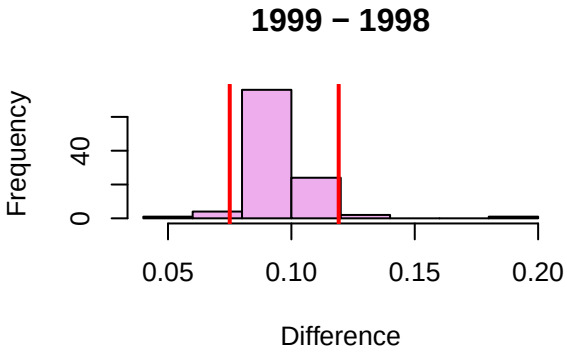



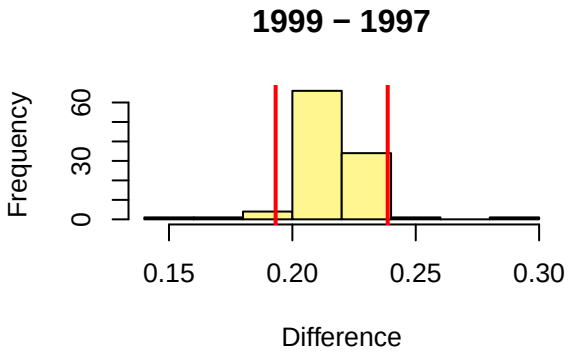

Number of nodes in k-cores where k > 1:

## Jackknife distributions of the differences in network statistics between time points

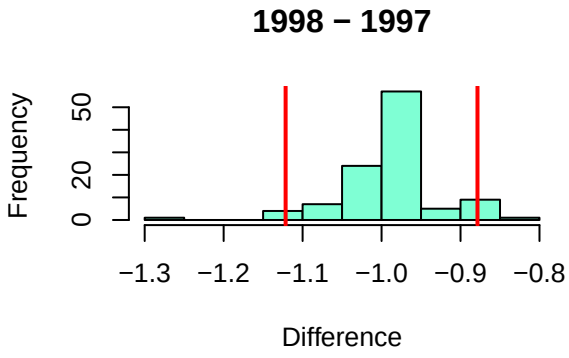
**The vertical red lines indicate the middle 95% of the distributions.**

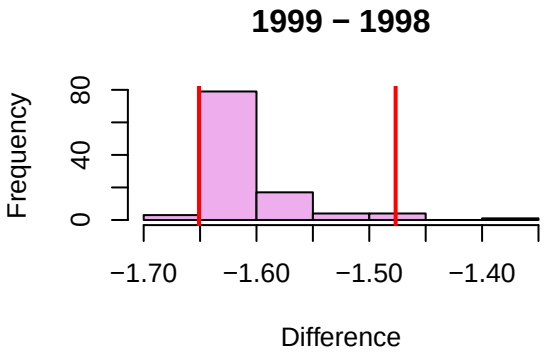


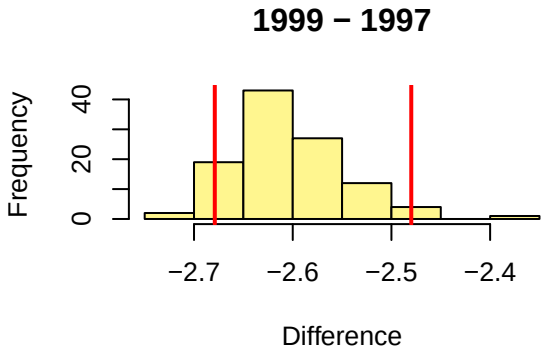



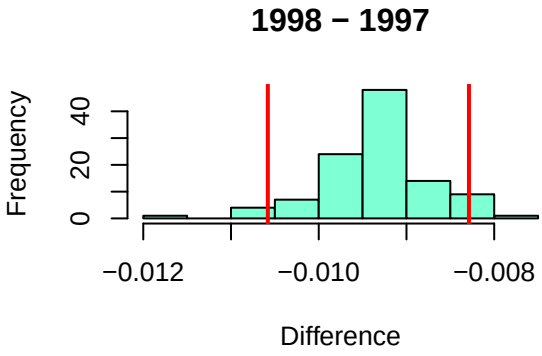

Transitivity:

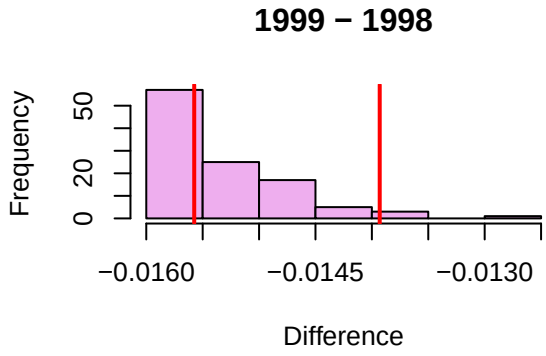


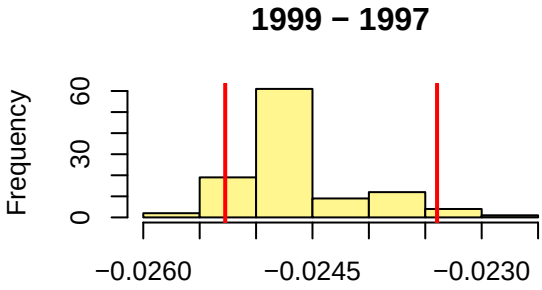



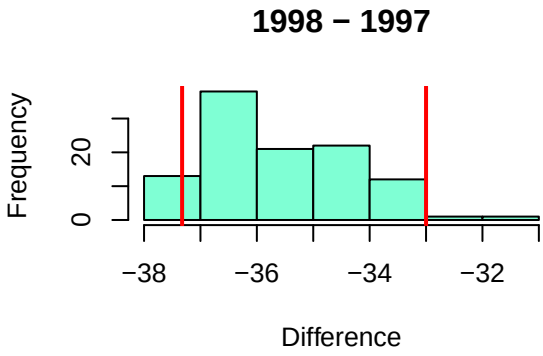

Mean Degree:

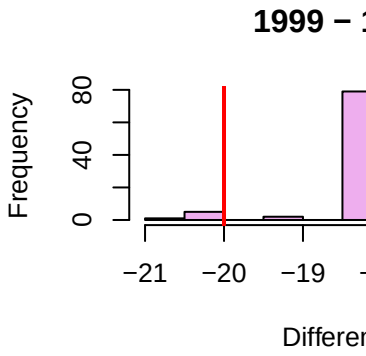


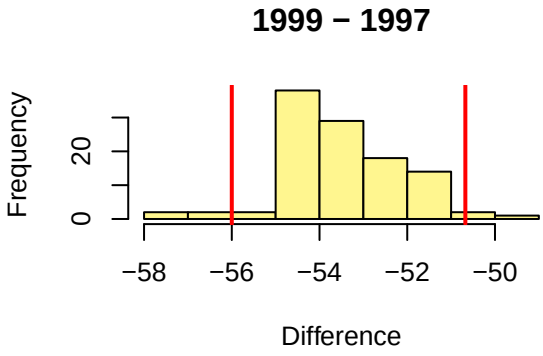




Edge Density:




Number of nodes in k-cores where k > 1:

**If we assume that the distributions are normal, do we see significance in the same places?**

**Bootstrap distributions:**

Transitivity:

```
##
##  Paired t-test
##
## data:  tboot_tg98 and tboot_tg97
## t = 47.425, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.1272570 0.1383706
## sample estimates:
## mean of the differences
##               0.1328138
```

```
##
##  Paired t-test
##
## data:  tboot_tg99 and tboot_tg98
## t = -17.296, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.06996305 -0.05556276
## sample estimates:
## mean of the differences
##             -0.06276291
```

```
##
```

```
##  Paired t-test
##
## data:  tboot_tg99 and tboot_tg97
## t = 19.945, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.06308207 0.07701970
## sample estimates:
## mean of the differences
##              0.07005088
```

Mean Degree:

```
##
##  Paired t-test
##
## data:  mdboot_tg98 and mdboot_tg97
## t = -225.97, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1.098824 -1.079695
## sample estimates:
## mean of the differences
##               -1.089259
```

```
##
##  Paired t-test
##
## data:  mdboot_tg99 and mdboot_tg98
## t = -320.83, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1.171273 -1.156875
## sample estimates:
## mean of the differences
##               -1.164074
```

```
##
##  Paired t-test
##
## data:  mdboot_tg99 and mdboot_tg97
## t = -523.06, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -2.261881 -2.244785
## sample estimates:
## mean of the differences
##               -2.253333
```

Edge Density:

```
##
##  Paired t-test
##
## data:  dboot_tg98 and dboot_tg97
## t = -223.04, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
```

```
## 95 percent confidence interval:
##  -0.01032643 -0.01014432
## sample estimates:
## mean of the differences
##             -0.01023538
```

```
##
##  Paired t-test
##
## data:  dboot_tg99 and dboot_tg98
## t = -294.27, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.01090725 -0.01076115
## sample estimates:
## mean of the differences
##              -0.0108342
```

```
##
##  Paired t-test
##
## data:  dboot_tg99 and dboot_tg97
## t = -529.54, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.02114852 -0.02099063
## sample estimates:
## mean of the differences
##             -0.02106957
```

Number of nodes in k-cores where k $> 1$:

```
##
##  Paired t-test
##
## data:  kboot_tg98 and kboot_tg97
## t = -121.34, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -29.06768 -28.13232
## sample estimates:
## mean of the differences
##                   -28.6
```

```
##
##  Paired t-test
##
## data:  kboot_tg99 and kboot_tg98
## t = -221.04, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -22.11677 -21.72323
## sample estimates:
## mean of the differences
##                  -21.92
```

```
##
```

```
##  Paired t-test
##
## data:  kboot_tg99 and kboot_tg97
## t = -207.83, df = 99, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -51.00232 -50.03768
## sample estimates:
## mean of the differences
##                  -50.52
```

**Jackknife distributions:**

Transitivity:

```
##
##  Paired t-test
##
## data:  tjack_tg98 and tjack_tg97
## t = 148.2, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.1182426 0.1214489
## sample estimates:
## mean of the differences
##               0.1198457
```

```
##
##  Paired t-test
##
## data:  tjack_tg99 and tjack_tg98
## t = 82.301, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.09701859 0.10180769
## sample estimates:
## mean of the differences
##              0.09941314
```

```
##
##  Paired t-test
##
## data:  tjack_tg99 and tjack_tg97
## t = 165.97, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  0.2166400 0.2218778
## sample estimates:
## mean of the differences
##               0.2192589
```

Mean Degree:

```
##
##  Paired t-test
##
## data:  mdjack_tg98 and mdjack_tg97
```

```
## t = -166.42, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1.0024545 -0.9788539
## sample estimates:
## mean of the differences
##              -0.9906542
```

```
##
##  Paired t-test
##
## data:  mdjack_tg99 and mdjack_tg98
## t = -332.62, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -1.624021 -1.604778
## sample estimates:
## mean of the differences
##               -1.614399
```

```
##
##  Paired t-test
##
## data:  mdjack_tg99 and mdjack_tg97
## t = -490.44, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -2.615583 -2.594524
## sample estimates:
## mean of the differences
##               -2.605054
```

Edge Density:

```
##
##  Paired t-test
##
## data:  djack_tg98 and djack_tg97
## t = -166.42, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.009457118 -0.009234471
## sample estimates:
## mean of the differences
##            -0.009345794
```

```
##
##  Paired t-test
##
## data:  djack_tg99 and djack_tg98
## t = -332.62, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.01532095 -0.01513941
## sample estimates:
## mean of the differences
```

```
##             -0.01523018
```

```
##
##  Paired t-test
##
## data:  djack_tg99 and djack_tg97
## t = -490.44, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.02467531 -0.02447664
## sample estimates:
## mean of the differences
##             -0.02457598
```

Number of nodes in k-cores where k $>$ 1:

```
##
##  Paired t-test
##
## data:  kjack_tg98 and kjack_tg97
## t = -268.25, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -35.38924 -34.87002
## sample estimates:
## mean of the differences
##               -35.12963
```

```
##
##  Paired t-test
##
## data:  kjack_tg99 and kjack_tg98
## t = -227.41, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -18.03549 -17.72377
## sample estimates:
## mean of the differences
##               -17.87963
```

```
##
##  Paired t-test
##
## data:  kjack_tg99 and kjack_tg97
## t = -390.46, df = 107, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -53.27839 -52.74013
## sample estimates:
## mean of the differences
##               -53.00926
```