Networks: Project 3

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Make a CUG test on a network of your choice.

2 Network

The data is the network of American football games between Division IA colleges during regular season Fall 2000, as compiled by M. Girvan and M. Newman (Girvan and Newman (2002)).

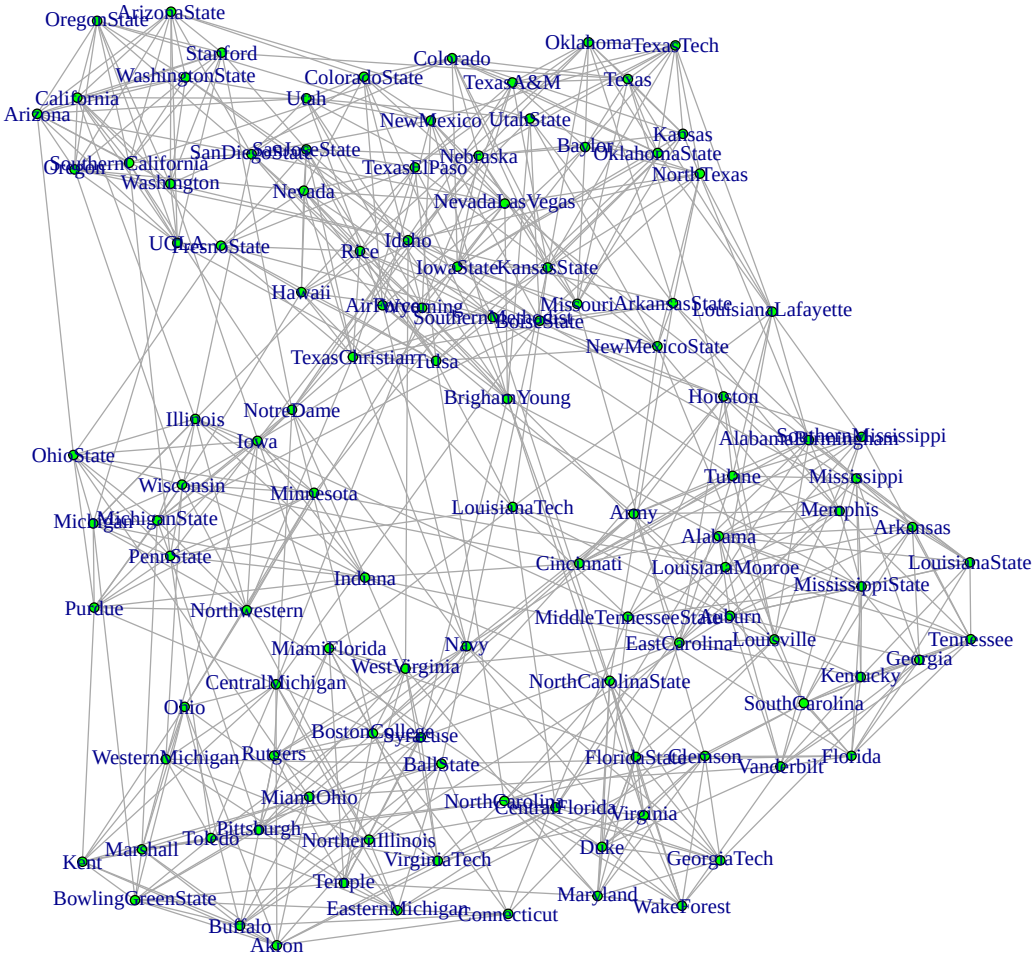
2.1 Basic Network Characteristics

The nodes represent web pages, each page describes some Wikipedia social norm. The links are the HTTP reference from one page to another.

It's a directed graph by its nature, no weights assigned to the links.

Property	Value
Vertices	115
Edges	613
Directed	No
Weighted	No
Average degree	10.7
Diameter	4
Acyclic	No
Edge density	0.0935163996948894
Average Path Length	2.50816170861937
Transitivity (global)	0.407239819004525

```
coords_fr = layout.fruchterman.reingold(net, weights=E(net)$weight)
plot(net, vertex.color="green", layout = coords_fr, vertex.label = V(net)$label, vertex.size = 2)
```



3 Analysis

```
## Loading required package: tergm
```

```
## Loading required package: statnet.common
```

```
##
## Attaching package: 'statnet.common'
```

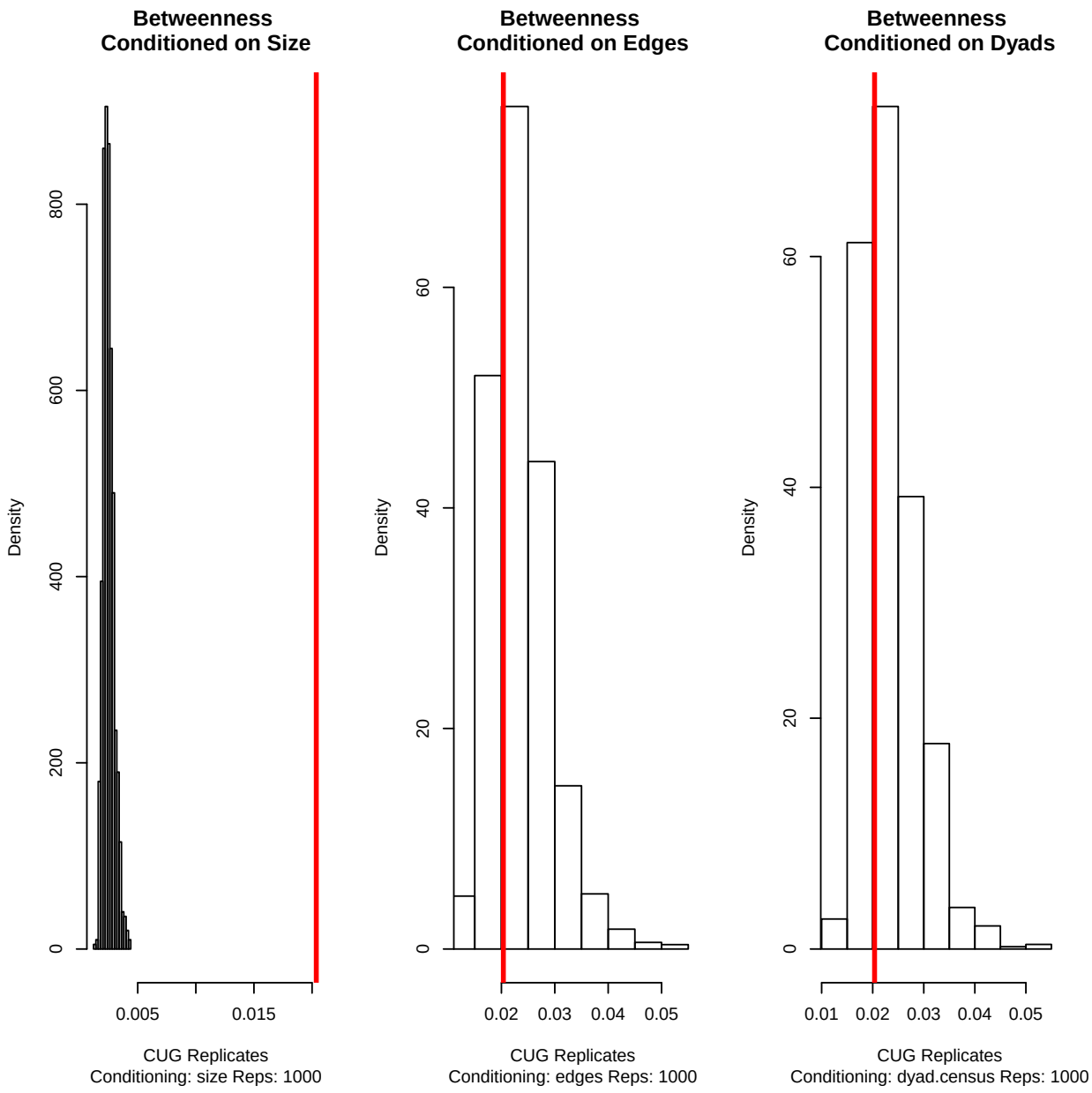
```
## The following object is masked from 'package:base':
##
##     order
```

```
## Loading required package: ergm
```

```
## Loading required package: network
## network: Classes for Relational Data
## Version 1.13.0.1 created on 2015-08-31.
## copyright (c) 2005, Carter T. Butts, University of California-Irvine
##                     Mark S. Handcock, University of California -- Los Angeles
##                     David R. Hunter, Penn State University
##                     Martina Morris, University of Washington
##                     Skye Bender-deMoll, University of Washington
##  For citation information, type citation("network").
##  Type help("network-package") to get started.
##
## Attaching package: 'network'
## The following objects are masked from 'package:igraph':
##
##     %c%, %s%, add.edges, add.vertices, delete.edges,
##     delete.vertices, get.edge.attribute, get.edges,
##     get.vertex.attribute, is.bipartite, is.directed,
##     list.edge.attributes, list.vertex.attributes,
##     set.edge.attribute, set.vertex.attribute
##
## ergm: version 3.8.0, created on 2017-08-18
## Copyright (c) 2017, Mark S. Handcock, University of California -- Los Angeles
##                     David R. Hunter, Penn State University
##                     Carter T. Butts, University of California -- Irvine
##                     Steven M. Goodreau, University of Washington
##                     Pavel N. Krivitsky, University of Wollongong
##                     Martina Morris, University of Washington
##                     with contributions from
##                     Li Wang
##                     Kirk Li, University of Washington
##                     Skye Bender-deMoll, University of Washington
## Based on "statnet" project software (statnet.org).
## For license and citation information see statnet.org/attribution
## or type citation("ergm").
## NOTE: Versions before 3.6.1 had a bug in the implementation of the
## bd() constriant which distorted the sampled distribution somewhat.
## In addition, Sampson's Monks datasets had mislabeled vertices. See
## the NEWS and the documentation for more details.
##
## Attaching package: 'ergm'
## The following objects are masked from 'package:statnet.common':
##
##     colMeans.mcmc.list, sweep.mcmc.list
## Loading required package: networkDynamic
##
## networkDynamic: version 0.9.0, created on 2016-01-12
## Copyright (c) 2016, Carter T. Butts, University of California -- Irvine
##                     Ayn Leslie-Cook, University of Washington
##                     Pavel N. Krivitsky, University of Wollongong
```

```
##                     Skye Bender-deMoll, University of Washington
##                     with contributions from
##                     Zack Almquist, University of California -- Irvine
##                     David R. Hunter, Penn State University
##                     Li Wang
##                     Kirk Li, University of Washington
##                     Steven M. Goodreau, University of Washington
##                     Jeffrey Horner
##                     Martina Morris, University of Washington
## Based on "statnet" project software (statnet.org).
## For license and citation information see statnet.org/attribution
## or type citation("networkDynamic").

## Warning: replacing previous import 'statnet.common::colMeans.mcmc.list' by
## 'ergm::colMeans.mcmc.list' when loading 'tergm'

## Warning: replacing previous import 'statnet.common::sweep.mcmc.list' by
## 'ergm::sweep.mcmc.list' when loading 'tergm'

##
## tergm: version 3.4.1, created on 2017-09-12
## Copyright (c) 2017, Pavel N. Krivitsky, University of Wollongong
##                     Mark S. Handcock, University of California -- Los Angeles
##                     with contributions from
##                     David R. Hunter, Penn State University
##                     Steven M. Goodreau, University of Washington
##                     Martina Morris, University of Washington
##                     Nicole Bohme Carnegie, New York University
##                     Carter T. Butts, University of California -- Irvine
##                     Ayn Leslie-Cook, University of Washington
##                     Skye Bender-deMoll
##                     Li Wang
##                     Kirk Li, University of Washington
## Based on "statnet" project software (statnet.org).
## For license and citation information see statnet.org/attribution
## or type citation("tergm").

## Loading required package: ergm.count

## Warning: replacing previous import 'statnet.common::colMeans.mcmc.list' by
## 'ergm::colMeans.mcmc.list' when loading 'ergm.count'

## Warning: replacing previous import 'statnet.common::sweep.mcmc.list' by
## 'ergm::sweep.mcmc.list' when loading 'ergm.count'

##
## ergm.count: version 3.2.2, created on 2016-03-29
## Copyright (c) 2016, Pavel N. Krivitsky, University of Wollongong
##                     with contributions from
##                     Mark S. Handcock, University of California -- Los Angeles
##                     David R. Hunter, Penn State University
## Based on "statnet" project software (statnet.org).
## For license and citation information see statnet.org/attribution
## or type citation("ergm.count").

## NOTE: The form of the term 'CMP' has been changed in version 3.2
## of 'ergm.count'. See the news or help('CMP') for more information.
```

```
## Loading required package: sna
## sna: Tools for Social Network Analysis
## Version 2.4 created on 2016-07-23.
## copyright (c) 2005, Carter T. Butts, University of California-Irvine
##  For citation information, type citation("sna").
##  Type help(package="sna") to get started.
##
## Attaching package: 'sna'
## The following objects are masked from 'package:igraph':
##
##     betweenness, bonpow, closeness, components, degree,
##     dyad.census, evcent, hierarchy, is.connected, neighborhood,
##     triad.census
## Warning: replacing previous import 'statnet.common::colMeans.mcmc.list' by
## 'ergm::colMeans.mcmc.list' when loading 'statnet'
## Warning: replacing previous import 'statnet.common::sweep.mcmc.list' by
## 'ergm::sweep.mcmc.list' when loading 'statnet'
##
## statnet: version 2016.9, created on 2016-08-29
## Copyright (c) 2016, Mark S. Handcock, University of California -- Los Angeles
##                     David R. Hunter, Penn State University
##                     Carter T. Butts, University of California -- Irvine
##                     Steven M. Goodreau, University of Washington
##                     Pavel N. Krivitsky, University of Wollongong
##                     Skye Bender-deMoll
##                     Martina Morris, University of Washington
## Based on "statnet" project software (statnet.org).
## For license and citation information see statnet.org/attribution
## or type citation("statnet").
## unable to reach CRAN
##       Betweenness PctGreater PctLess
## Size   0.02036347      0.000   1.000
## Edges  0.02036347      0.691   0.309
## Dyads  0.02036347      0.647   0.353
```



References

Girvan, M., and M. E. J. Newman. 2002. "Community Structure in Social and Biological Networks." *Proceedings of the National Academy of Sciences* 99 (12). National Academy of Sciences:7821–6. https://doi.org/10.1073/pnas.122653799.