

# Chapter 1

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## Libraries and data used

### Libraries

```
library(statnet)

## Loading required package: tergm
## Loading required package: ergm
## Loading required package: network

## network: Classes for Relational Data
## Version 1.16.0 created on 2019-11-30.
## 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.

##
## ergm: version 3.10.4, created on 2019-06-10
## Copyright (c) 2019, 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
##           Chad Klumb
## 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.

## NOTE: Some common term arguments pertaining to vertex attribute and
## level selection have changed in 3.10.0. See terms help for more
## details. Use 'options(ergm.term=list(version="3.9.4"))' to use old
## behavior.

## Loading required package: networkDynamic

##
## networkDynamic: version 0.10.1, created on 2020-01-16
## Copyright (c) 2020, 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").

##
## tergm: version 3.6.1, created on 2019-06-12
## Copyright (c) 2019, 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

##
## ergm.count: version 3.4.0, created on 2019-05-15
## Copyright (c) 2019, 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

## Loading required package: statnet.common

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

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

## sna: Tools for Social Network Analysis
## Version 2.5 created on 2019-12-09.
## copyright (c) 2005, Carter T. Butts, University of California-Irvine
## For citation information, type citation("sna").
## Type help(package="sna") to get started.

## Loading required package: tsna

##
## statnet: version 2019.6, created on 2019-06-13
## Copyright (c) 2019, 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
library(UserNetR)

```

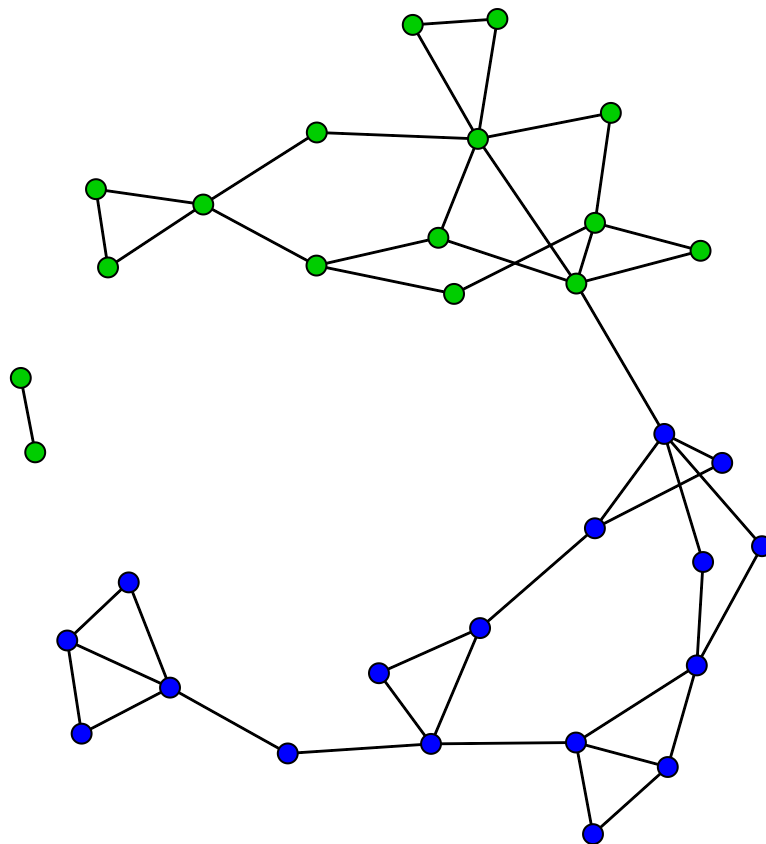
## Data

```
data(Moreno)
```

## Simple Visualization

```
gender <- Moreno %v% "gender"
```

```
plot(Moreno,  
     vertex.col = gender + 2,  
     vertex.cex = 1.2)
```



## Basic Description

### Size

```
network.size(Moreno)
```

```
## [1] 33
summary(Moreno, print.adj = FALSE)

## Network attributes:
##   vertices = 33
##   directed = FALSE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##   bipartite = FALSE
##   total edges = 46
##   missing edges = 0
##   non-missing edges = 46
##   density = 0.08712121
##
## Vertex attributes:
##
##   gender:
##     numeric valued attribute
##     attribute summary:
##       Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1.000   1.000   2.000   1.515   2.000   2.000
##   vertex.names:
##     character valued attribute
##     33 valid vertex names
##
## No edge attributes
```

## Density

```
den_hand <- 2*46/(33*32)
gden(Moreno)
```

```
## [1] 0.08712121
```

## components

```
components(Moreno)
```

```
## [1] 2
```

## Diameter

```
lgc <- component.largest(Moreno,
                          result = "graph")
gd <- geodist(lgc)
max(gd$gdist)
```

```
## [1] 11
```