INFX 576: Problem Set 3 - Selective Mixing*

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Due: Thursday, February 2, 2017

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Instructions: Before beginning this assignment, please ensure you have access to R and RStudio.

1. Download the `problemset3.Rmd` file from Canvas.
2. Replace the "Insert Your Name Here" text in the `author:` field with your own full name. Any collaborators must be listed on the top of your assignment.
3. Be sure to include well-documented (e.g. commented) code chucks, figures and clearly written text chunk explanations as necessary. Any figures should be clearly labeled and appropriately referenced within the text.
4. Collaboration on problem sets is acceptable, and even encouraged, but each student must turn in an individual write-up in his or her own words and his or her own work. The names of all collaborators must be listed on each assignment. Do not copy-and-paste from other students' responses or code.
5. When you have completed the assignment and have **checked** that your code both runs in the Console and knits correctly when you click `Knit PDF`, rename the R Markdown file to `YourLastName_YourFirstName_ps3.Rmd`, knit a PDF and submit the PDF file on Canvas.

Setup: In this problem set you will need, at minimum, the following R packages.

```
# Load standard libraries
library(statnet)
library(network)
data(emon)
```

Problem 1: Selective Mixing We will begin with an examination of selective mixing in the Drabek et al. EMON data (which can be accessed in the `network` package via the command `data(emon)`). Recall the `emon` object is a list of seven networks, such that `emon[[1]]` is the ith network object. (See `?emon` for details regarding the dataset.)

(a) Visualizing Networks This data set consists of seven individual network data sets of emergent multiorganizational networks (EMONs) in the context of search and rescue activities. These data sets are: the Cheyenne SAR EMON, the Hurricane Frederic SAR EMON, the Lake Pomona SAR EMON, the Mt. Si SAR EMON, the Mt. St. Helens SAR EMON, the Texas Hill Country SAR EMON, and the Wichita Falls SAR EMON. We interpret the relationships in each of these networks as one of salient communication.

To begin, plot each of the seven networks, coloring vertices by the "Sponsorship" vertex attribute. With each plot, include a legend showing how sponsorship is colored. Comment on what you see.

```
names(emon)
```

*Problems originally written by C.T. Butts (2009)

```
## [1] "Cheyenne"     "HurrFrederic" "LakePomona"   "MtSi"
## [5] "MtStHelens"   "Texas"        "Wichita"
```

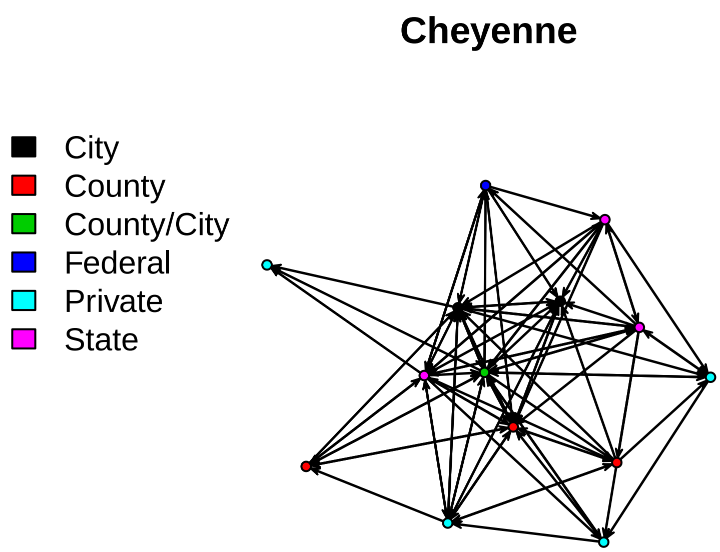
```r
par(mfrow=c(1,1))
#Cheyenne network
summary(emon$Cheyenne)
```

```
## Network attributes:
##   vertices = 14
##   directed = TRUE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##  total edges = 83
##    missing edges = 0
##    non-missing edges = 83
##  density = 0.456044
##
## Vertex attributes:
##
##  Command.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   0.500   2.500   8.857  10.000  40.000
##
##  Decision.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     0.0     0.5     4.0    10.0    17.5    50.0
##
##  Formalization:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   1.000   1.000   1.308   1.000   3.000       1
##
##  Location:
##    character valued attribute
##    attribute summary:
##  L
## 14
##
##  Paid.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.00    7.00   10.00   71.23   70.00  400.00       1
##
##  Sponsorship:
##    character valued attribute
##    attribute summary:
##        City      County County/City     Federal     Private       State
```

```
##            2           3           1           1           4           3
##   vertex.names:
##    character valued attribute
##    14 valid vertex names
##
##  Volunteer.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##     0.0     0.0    20.0   191.3    57.5  2000.0       2
##
## Edge attributes:
##
##  Frequency:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   1.000   1.723   3.000   4.000
##
## Network edgelist matrix:
##       [,1] [,2]
##  [1,]    2    1
##  [2,]    3    1
##  [3,]    8    1
##  [4,]    9    1
##  [5,]   14    1
##  [6,]    1    2
##  [7,]    3    2
##  [8,]    4    2
##  [9,]    8    2
## [10,]    1    3
## [11,]    2    3
## [12,]    4    3
## [13,]    7    3
## [14,]   12    3
## [15,]   13    3
## [16,]    1    4
## [17,]    3    4
## [18,]    8    4
## [19,]    1    5
## [20,]    3    5
## [21,]    8    5
## [22,]   14    5
## [23,]    3    6
## [24,]    8    6
## [25,]    9    6
## [26,]    1    7
## [27,]    2    7
## [28,]    3    7
## [29,]    4    7
## [30,]    5    7
## [31,]    8    7
## [32,]    9    7
## [33,]   10    7
```

```
## [34,]   11    7
## [35,]   12    7
## [36,]   13    7
## [37,]    1    8
## [38,]    2    8
## [39,]    3    8
## [40,]    5    8
## [41,]    7    8
## [42,]    9    8
## [43,]   12    8
## [44,]   13    8
## [45,]   14    8
## [46,]    1    9
## [47,]    2    9
## [48,]    3    9
## [49,]    4    9
## [50,]    8    9
## [51,]   10    9
## [52,]   11    9
## [53,]   12    9
## [54,]   13    9
## [55,]    1   10
## [56,]    2   10
## [57,]    3   10
## [58,]    4   10
## [59,]    7   10
## [60,]    8   10
## [61,]    9   10
## [62,]   11   10
## [63,]   13   10
## [64,]    1   11
## [65,]    3   11
## [66,]    7   11
## [67,]    8   11
## [68,]   13   11
## [69,]    3   12
## [70,]    7   12
## [71,]    8   12
## [72,]   13   12
## [73,]    3   13
## [74,]    5   13
## [75,]    7   13
## [76,]    8   13
## [77,]    9   13
## [78,]   11   13
## [79,]    1   14
## [80,]    2   14
## [81,]    8   14
## [82,]    9   14
## [83,]   11   14
```

```r
plot(emon$Cheyenne, vertex.col="Sponsorship", main="Cheyenne")
vals <- sort(unique(emon$Cheyenne%v%"Sponsorship"))
legend("topleft",fill = 1:length(vals),legend=vals, bty="n")
```




```r
#HurrFrederic network
summary(emon$HurrFrederic)
```

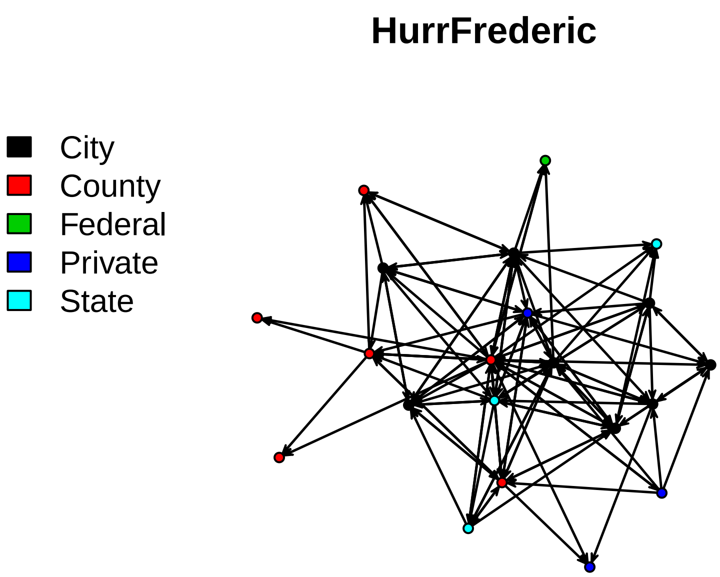
```
## Network attributes:
##   vertices = 21
##   directed = TRUE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##  total edges = 118
##    missing edges = 0
##    non-missing edges = 118
##  density = 0.2809524
##
## Vertex attributes:
##
##  Command.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   4.000   8.000   9.385  10.000  30.000       8
##
##  Decision.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    2.00    6.00    8.00    9.00    9.25   30.00       9
##
##  Formalization:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   1.000   2.000   1.737   2.000   3.000       2
##
##  Location:
##    character valued attribute
```

```
##    attribute summary:
##  B  L NL
##  1 19  1
##
##  Paid.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.00    2.25   20.00   68.11   37.50  800.00       3
##
##  Sponsorship:
##    character valued attribute
##    attribute summary:
##    City  County Federal Private   State
##       8       6       1       3       3
##   vertex.names:
##    character valued attribute
##    21 valid vertex names
##
##  Volunteer.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.00    0.00   18.50   66.11   50.00  400.00       3
##
## Edge attributes:
##
##  Frequency:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   1.000   1.737   3.000   4.000
##
## Network edgelist matrix:
##        [,1] [,2]
##   [1,]    5    1
##   [2,]   14    1
##   [3,]   16    1
##   [4,]    5    2
##   [5,]   14    2
##   [6,]   16    2
##   [7,]   19    2
##   [8,]   20    2
##   [9,]    4    3
##  [10,]    5    3
##  [11,]    6    3
##  [12,]   14    3
##  [13,]    5    4
##  [14,]   13    4
##  [15,]   14    4
##  [16,]   15    4
##  [17,]   16    4
##  [18,]   17    4
##  [19,]   18    4
```

```
##  [20,]   19    4
##  [21,]   20    4
##  [22,]    1    5
##  [23,]    3    5
##  [24,]    4    5
##  [25,]    6    5
##  [26,]    7    5
##  [27,]    9    5
##  [28,]   11    5
##  [29,]   14    5
##  [30,]   15    5
##  [31,]   16    5
##  [32,]   19    5
##  [33,]   20    5
##  [34,]    3    6
##  [35,]    4    6
##  [36,]    5    6
##  [37,]    7    6
##  [38,]    9    6
##  [39,]   13    6
##  [40,]   14    6
##  [41,]   17    6
##  [42,]   20    6
##  [43,]    4    7
##  [44,]    5    7
##  [45,]    6    7
##  [46,]   13    7
##  [47,]   14    7
##  [48,]   18    7
##  [49,]    5    8
##  [50,]    6    8
##  [51,]   15    8
##  [52,]    5    9
##  [53,]    5   10
##  [54,]    7   10
##  [55,]    5   11
##  [56,]    7   11
##  [57,]   16   11
##  [58,]   18   11
##  [59,]    5   12
##  [60,]    7   12
##  [61,]    4   13
##  [62,]    6   13
##  [63,]   14   13
##  [64,]   16   13
##  [65,]   17   13
##  [66,]   18   13
##  [67,]   19   13
##  [68,]   20   13
##  [69,]    3   14
##  [70,]    4   14
##  [71,]    5   14
##  [72,]    6   14
##  [73,]    9   14
```

```
##  [74,]   13   14
##  [75,]   15   14
##  [76,]   20   14
##  [77,]    5   15
##  [78,]    9   15
##  [79,]   14   15
##  [80,]   16   15
##  [81,]   19   15
##  [82,]   21   15
##  [83,]    4   16
##  [84,]    5   16
##  [85,]   11   16
##  [86,]   14   16
##  [87,]   17   16
##  [88,]   18   16
##  [89,]   19   16
##  [90,]    3   17
##  [91,]    4   17
##  [92,]    5   17
##  [93,]    6   17
##  [94,]   13   17
##  [95,]   14   17
##  [96,]   16   17
##  [97,]   18   17
##  [98,]    5   18
##  [99,]   13   18
## [100,]   16   18
## [101,]   17   18
## [102,]    4   19
## [103,]    5   19
## [104,]   20   19
## [105,]   21   19
## [106,]    3   20
## [107,]    4   20
## [108,]    5   20
## [109,]    6   20
## [110,]   13   20
## [111,]   14   20
## [112,]   19   20
## [113,]   21   20
## [114,]    5   21
## [115,]    9   21
## [116,]   13   21
## [117,]   19   21
## [118,]   20   21
```

```
plot(emon$HurrFrederic, vertex.col="Sponsorship", main="HurrFrederic")
vals <- sort(unique(emon$HurrFrederic%v%"Sponsorship"))
legend("topleft",fill = 1:length(vals),legend=vals, bty="n")
```




```r
#LakePomona network
summary(emon$LakePomona)
```

```
## Network attributes:
##   vertices = 20
##   directed = TRUE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##  total edges = 148
##    missing edges = 0
##    non-missing edges = 148
##  density = 0.3894737
##
## Vertex attributes:
##
##  Command.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.50    1.35    9.50   14.97   18.40   58.40       9
##
##  Decision.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    2.10    2.85    9.50   17.13   22.90   57.90       9
##
##  Formalization:
##    integer valued attribute
##    20 values
##
##  Location:
##    character valued attribute
##    attribute summary:
```

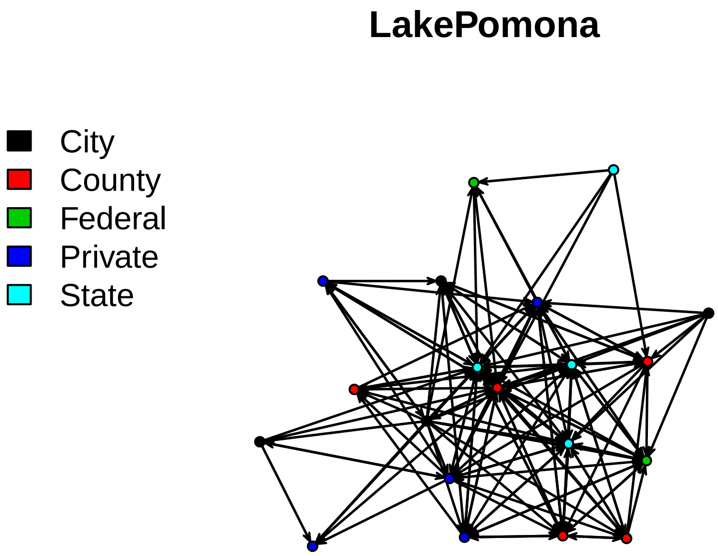
```
##  L NL
##  9 11
##
##  Paid.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   1.625   7.500  50.780  14.000 409.000       4
##
##  Sponsorship:
##    character valued attribute
##    attribute summary:
##    City  County Federal Private   State
##       4       5       2       5       4
##   vertex.names:
##    character valued attribute
##    20 valid vertex names
##
##  Volunteer.Staff:
##    integer valued attribute
##    20 values
##
## Edge attributes:
##
##  Frequency:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   1.000   1.811   3.000   4.000
##
## Network edgelist matrix:
##        [,1] [,2]
##   [1,]    2    1
##   [2,]    3    1
##   [3,]    4    1
##   [4,]    5    1
##   [5,]    6    1
##   [6,]    7    1
##   [7,]    8    1
##   [8,]    9    1
##   [9,]   10    1
##  [10,]   11    1
##  [11,]   12    1
##  [12,]   13    1
##  [13,]   14    1
##  [14,]   15    1
##  [15,]   16    1
##  [16,]   17    1
##  [17,]   18    1
##  [18,]   19    1
##  [19,]   20    1
##  [20,]    1    2
##  [21,]    4    2
##  [22,]    8    2
```

```
## [23,]   16    2
## [24,]   17    2
## [25,]   19    2
## [26,]    1    3
## [27,]    2    3
## [28,]    4    3
## [29,]    5    3
## [30,]    6    3
## [31,]    7    3
## [32,]    9    3
## [33,]   11    3
## [34,]   14    3
## [35,]   15    3
## [36,]   17    3
## [37,]    3    4
## [38,]    5    4
## [39,]    6    4
## [40,]    7    4
## [41,]   15    4
## [42,]    1    5
## [43,]    2    5
## [44,]    3    5
## [45,]    4    5
## [46,]    6    5
## [47,]    7    5
## [48,]    8    5
## [49,]    9    5
## [50,]   10    5
## [51,]   11    5
## [52,]   12    5
## [53,]   13    5
## [54,]   14    5
## [55,]   15    5
## [56,]   16    5
## [57,]   17    5
## [58,]   18    5
## [59,]   19    5
## [60,]   20    5
## [61,]    1    6
## [62,]    2    6
## [63,]    3    6
## [64,]    4    6
## [65,]    5    6
## [66,]    7    6
## [67,]    9    6
## [68,]   11    6
## [69,]   14    6
## [70,]   15    6
## [71,]   16    6
## [72,]   17    6
## [73,]   19    6
## [74,]    1    7
## [75,]    2    7
## [76,]    4    7
```

```
##  [77,]    5    7
##  [78,]    6    7
##  [79,]    9    7
##  [80,]   11    7
##  [81,]   12    7
##  [82,]   14    7
##  [83,]   15    7
##  [84,]   16    7
##  [85,]   17    7
##  [86,]   19    7
##  [87,]    1    9
##  [88,]    2    9
##  [89,]    3    9
##  [90,]    4    9
##  [91,]    6    9
##  [92,]    7    9
##  [93,]   11    9
##  [94,]   14    9
##  [95,]   15    9
##  [96,]   17    9
##  [97,]   19    9
##  [98,]    7   10
##  [99,]    8   10
## [100,]   15   10
## [101,]   17   10
## [102,]    1   11
## [103,]    3   11
## [104,]    5   11
## [105,]    6   11
## [106,]    9   11
## [107,]   15   11
## [108,]   16   11
## [109,]    5   12
## [110,]    6   12
## [111,]   11   12
## [112,]   14   12
## [113,]   15   12
## [114,]    5   13
## [115,]   14   13
## [116,]   15   13
## [117,]   18   13
## [118,]    2   14
## [119,]    4   14
## [120,]    5   14
## [121,]    6   14
## [122,]   15   14
## [123,]   17   14
## [124,]   18   14
## [125,]    1   15
## [126,]   20   15
## [127,]    1   16
## [128,]    2   16
## [129,]    5   16
## [130,]    7   16
```

```
## [131,]   15   16
## [132,]   20   16
## [133,]    1   17
## [134,]    2   17
## [135,]    3   17
## [136,]    5   17
## [137,]    9   17
## [138,]   12   17
## [139,]   14   17
## [140,]   15   17
## [141,]   19   17
## [142,]   20   17
## [143,]   14   18
## [144,]   15   18
## [145,]    1   20
## [146,]    5   20
## [147,]   14   20
## [148,]   15   20
```

```r
plot(emon$LakePomona, vertex.col="Sponsorship", main="LakePomona")
vals <- sort(unique(emon$LakePomona%v%"Sponsorship"))
legend("topleft",fill = 1:length(vals),legend=vals, bty="n")
```




```r
#MtSi network
summary(emon$MtSi)
```

```
## Network attributes:
##   vertices = 13
##   directed = TRUE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##  total edges = 33
##    missing edges = 0
##    non-missing edges = 33
```

```
##  density = 0.2115385
##
## Vertex attributes:
##
##  Command.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.00    5.25    9.50   18.25   25.00   60.00       5
##
##  Decision.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.00    7.00    8.50   20.12   32.50   60.00       5
##
##  Formalization:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##     1.0     1.0     1.0     1.2     1.0     2.0       3
##
##  Location:
##    character valued attribute
##    attribute summary:
##  L NL
##  9  4
##
##  Paid.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.00    0.00    0.00   26.10   15.25  200.00       3
##
##  Sponsorship:
##    character valued attribute
##    attribute summary:
##  County Federal Private   State
##       2       1       7       3
##   vertex.names:
##    character valued attribute
##    13 valid vertex names
##
##  Volunteer.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##     0.0     0.0    10.0    37.5    85.0   100.0       5
##
## Edge attributes:
##
##  Frequency:
##    numeric valued attribute
##    attribute summary:
```

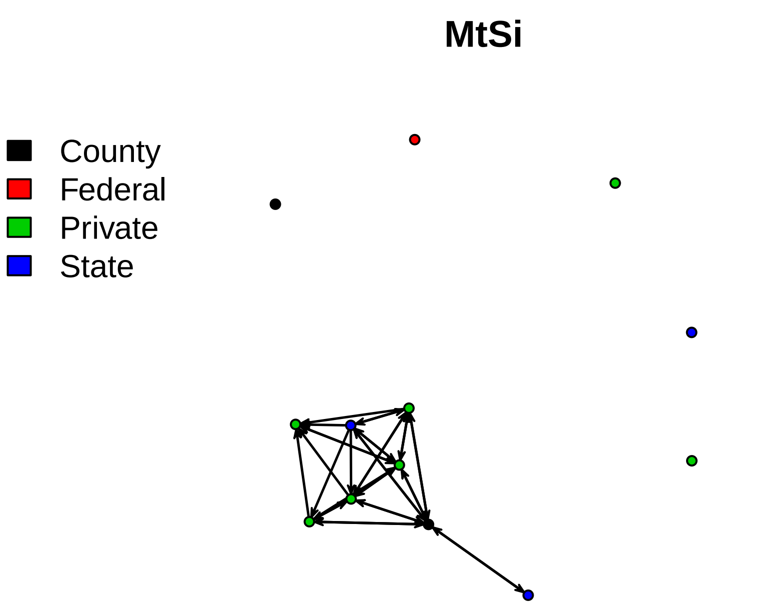
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   1.000   1.545   2.000   3.000
##
## Network adjacency matrix:
##                                                                   King.County.Police
## King.County.Police                                                                 0
## Skagit.County.Sheriff.s.Office                                                     0
## Seattle.ESAR..Explorer.Search.and.Rescue.                                          1
## Tacoma.Pierce.County.ESAR.Unit                                                     0
## Four.by.Four.Rescue.Council                                                        1
## German.Shepard.Search.Dogs.of.Washington.State                                     1
## Seattle.Mountain.Rescue.Council                                                    0
## Boeing.Helicopter.Team                                                             1
## Boeing.Employees.Amateur.Radio.Society..BEARS.                                     0
## Washingotn.Department.of.Emergency.Services                                        1
## US.Army...Ft.Lewis..116th.Aviation.Company.                                        0
## Washington.State.National.Guard..181st.Support.Batalion.                           1
## Washington.State.National.Guard..Army.Aviation.Support.Facility.                   0
##                                                                   Skagit.County.Sheriff.s.Office
## King.County.Police                                                                             0
## Skagit.County.Sheriff.s.Office                                                                 0
## Seattle.ESAR..Explorer.Search.and.Rescue.                                                      0
## Tacoma.Pierce.County.ESAR.Unit                                                                 0
## Four.by.Four.Rescue.Council                                                                    0
## German.Shepard.Search.Dogs.of.Washington.State                                                 0
## Seattle.Mountain.Rescue.Council                                                                0
## Boeing.Helicopter.Team                                                                         0
## Boeing.Employees.Amateur.Radio.Society..BEARS.                                                 0
## Washingotn.Department.of.Emergency.Services                                                    0
## US.Army...Ft.Lewis..116th.Aviation.Company.                                                    0
## Washington.State.National.Guard..181st.Support.Batalion.                                       0
## Washington.State.National.Guard..Army.Aviation.Support.Facility.                               0
##                                                                   Seattle.ESAR..Explorer.Search.and.R
## King.County.Police
## Skagit.County.Sheriff.s.Office
## Seattle.ESAR..Explorer.Search.and.Rescue.
## Tacoma.Pierce.County.ESAR.Unit
## Four.by.Four.Rescue.Council
## German.Shepard.Search.Dogs.of.Washington.State
## Seattle.Mountain.Rescue.Council
## Boeing.Helicopter.Team
## Boeing.Employees.Amateur.Radio.Society..BEARS.
## Washingotn.Department.of.Emergency.Services
## US.Army...Ft.Lewis..116th.Aviation.Company.
## Washington.State.National.Guard..181st.Support.Batalion.
## Washington.State.National.Guard..Army.Aviation.Support.Facility.
##                                                                   Tacoma.Pierce.County.ESAR.Unit
## King.County.Police                                                                             0
## Skagit.County.Sheriff.s.Office                                                                 0
## Seattle.ESAR..Explorer.Search.and.Rescue.                                                      0
## Tacoma.Pierce.County.ESAR.Unit                                                                 0
## Four.by.Four.Rescue.Council                                                                    0
## German.Shepard.Search.Dogs.of.Washington.State                                                 0
## Seattle.Mountain.Rescue.Council                                                                0
```

```
## Boeing.Helicopter.Team                                                       0
## Boeing.Employees.Amateur.Radio.Society..BEARS.                               0
## Washingotn.Department.of.Emergency.Services                                  0
## US.Army...Ft.Lewis..116th.Aviation.Company.                                  0
## Washington.State.National.Guard..181st.Support.Batalion.                     0
## Washington.State.National.Guard..Army.Aviation.Support.Facility.             0
##                                                          Four.by.Four.Rescue.Council
## King.County.Police                                                         1
## Skagit.County.Sheriff.s.Office                                             0
## Seattle.ESAR..Explorer.Search.and.Rescue.                                  1
## Tacoma.Pierce.County.ESAR.Unit                                             0
## Four.by.Four.Rescue.Council                                                0
## German.Shepard.Search.Dogs.of.Washington.State                             1
## Seattle.Mountain.Rescue.Council                                            0
## Boeing.Helicopter.Team                                                     1
## Boeing.Employees.Amateur.Radio.Society..BEARS.                             1
## Washingotn.Department.of.Emergency.Services                                0
## US.Army...Ft.Lewis..116th.Aviation.Company.                                0
## Washington.State.National.Guard..181st.Support.Batalion.                   1
## Washington.State.National.Guard..Army.Aviation.Support.Facility.           0
##                                                          German.Shepard.Search.Dogs.of.Washi
## King.County.Police
## Skagit.County.Sheriff.s.Office
## Seattle.ESAR..Explorer.Search.and.Rescue.
## Tacoma.Pierce.County.ESAR.Unit
## Four.by.Four.Rescue.Council
## German.Shepard.Search.Dogs.of.Washington.State
## Seattle.Mountain.Rescue.Council
## Boeing.Helicopter.Team
## Boeing.Employees.Amateur.Radio.Society..BEARS.
## Washingotn.Department.of.Emergency.Services
## US.Army...Ft.Lewis..116th.Aviation.Company.
## Washington.State.National.Guard..181st.Support.Batalion.
## Washington.State.National.Guard..Army.Aviation.Support.Facility.
##                                                          Seattle.Mountain.Rescue.Council
## King.County.Police                                                             0
## Skagit.County.Sheriff.s.Office                                                 0
## Seattle.ESAR..Explorer.Search.and.Rescue.                                      0
## Tacoma.Pierce.County.ESAR.Unit                                                 0
## Four.by.Four.Rescue.Council                                                    0
## German.Shepard.Search.Dogs.of.Washington.State                                 0
## Seattle.Mountain.Rescue.Council                                                0
## Boeing.Helicopter.Team                                                         0
## Boeing.Employees.Amateur.Radio.Society..BEARS.                                 0
## Washingotn.Department.of.Emergency.Services                                    0
## US.Army...Ft.Lewis..116th.Aviation.Company.                                    0
## Washington.State.National.Guard..181st.Support.Batalion.                       0
## Washington.State.National.Guard..Army.Aviation.Support.Facility.               0
##                                                          Boeing.Helicopter.Team
## King.County.Police                                                            1
## Skagit.County.Sheriff.s.Office                                                0
## Seattle.ESAR..Explorer.Search.and.Rescue.                                     1
## Tacoma.Pierce.County.ESAR.Unit                                                0
## Four.by.Four.Rescue.Council                                                   1
```

```
## German.Shepard.Search.Dogs.of.Washington.State                                         0
## Seattle.Mountain.Rescue.Council                                                        0
## Boeing.Helicopter.Team                                                                 0
## Boeing.Employees.Amateur.Radio.Society..BEARS.                                         0
## Washingotn.Department.of.Emergency.Services                                            0
## US.Army...Ft.Lewis..116th.Aviation.Company.                                            0
## Washington.State.National.Guard..181st.Support.Batalion.                               1
## Washington.State.National.Guard..Army.Aviation.Support.Facility.                       0
##                                                                   Boeing.Employees.Amateur.Radio.Soci
## King.County.Police
## Skagit.County.Sheriff.s.Office
## Seattle.ESAR..Explorer.Search.and.Rescue.
## Tacoma.Pierce.County.ESAR.Unit
## Four.by.Four.Rescue.Council
## German.Shepard.Search.Dogs.of.Washington.State
## Seattle.Mountain.Rescue.Council
## Boeing.Helicopter.Team
## Boeing.Employees.Amateur.Radio.Society..BEARS.
## Washingotn.Department.of.Emergency.Services
## US.Army...Ft.Lewis..116th.Aviation.Company.
## Washington.State.National.Guard..181st.Support.Batalion.
## Washington.State.National.Guard..Army.Aviation.Support.Facility.
##                                                                   Washingotn.Department.of.Emergency.S
## King.County.Police
## Skagit.County.Sheriff.s.Office
## Seattle.ESAR..Explorer.Search.and.Rescue.
## Tacoma.Pierce.County.ESAR.Unit
## Four.by.Four.Rescue.Council
## German.Shepard.Search.Dogs.of.Washington.State
## Seattle.Mountain.Rescue.Council
## Boeing.Helicopter.Team
## Boeing.Employees.Amateur.Radio.Society..BEARS.
## Washingotn.Department.of.Emergency.Services
## US.Army...Ft.Lewis..116th.Aviation.Company.
## Washington.State.National.Guard..181st.Support.Batalion.
## Washington.State.National.Guard..Army.Aviation.Support.Facility.
##                                                                   US.Army...Ft.Lewis..116th.Aviation.C
## King.County.Police
## Skagit.County.Sheriff.s.Office
## Seattle.ESAR..Explorer.Search.and.Rescue.
## Tacoma.Pierce.County.ESAR.Unit
## Four.by.Four.Rescue.Council
## German.Shepard.Search.Dogs.of.Washington.State
## Seattle.Mountain.Rescue.Council
## Boeing.Helicopter.Team
## Boeing.Employees.Amateur.Radio.Society..BEARS.
## Washingotn.Department.of.Emergency.Services
## US.Army...Ft.Lewis..116th.Aviation.Company.
## Washington.State.National.Guard..181st.Support.Batalion.
## Washington.State.National.Guard..Army.Aviation.Support.Facility.
##                                                                   Washington.State.National.Guard..18
## King.County.Police
## Skagit.County.Sheriff.s.Office
## Seattle.ESAR..Explorer.Search.and.Rescue.
```

```
## Tacoma.Pierce.County.ESAR.Unit
## Four.by.Four.Rescue.Council
## German.Shepard.Search.Dogs.of.Washington.State
## Seattle.Mountain.Rescue.Council
## Boeing.Helicopter.Team
## Boeing.Employees.Amateur.Radio.Society..BEARS.
## Washingotn.Department.of.Emergency.Services
## US.Army...Ft.Lewis..116th.Aviation.Company.
## Washington.State.National.Guard..181st.Support.Batalion.
## Washington.State.National.Guard..Army.Aviation.Support.Facility.
##                                                                  Washington.State.National.Guard..Arm
## King.County.Police
## Skagit.County.Sheriff.s.Office
## Seattle.ESAR..Explorer.Search.and.Rescue.
## Tacoma.Pierce.County.ESAR.Unit
## Four.by.Four.Rescue.Council
## German.Shepard.Search.Dogs.of.Washington.State
## Seattle.Mountain.Rescue.Council
## Boeing.Helicopter.Team
## Boeing.Employees.Amateur.Radio.Society..BEARS.
## Washingotn.Department.of.Emergency.Services
## US.Army...Ft.Lewis..116th.Aviation.Company.
## Washington.State.National.Guard..181st.Support.Batalion.
## Washington.State.National.Guard..Army.Aviation.Support.Facility.
```

```
plot(emon$MtSi, vertex.col="Sponsorship", main="MtSi")
vals <- sort(unique(emon$MtSi%v%"Sponsorship"))
legend("topleft",fill = 1:length(vals),legend=vals, bty="n")
```




```
#MtStHelens network
summary(emon$MtStHelens)
```

```
## Network attributes:
##   vertices = 27
```

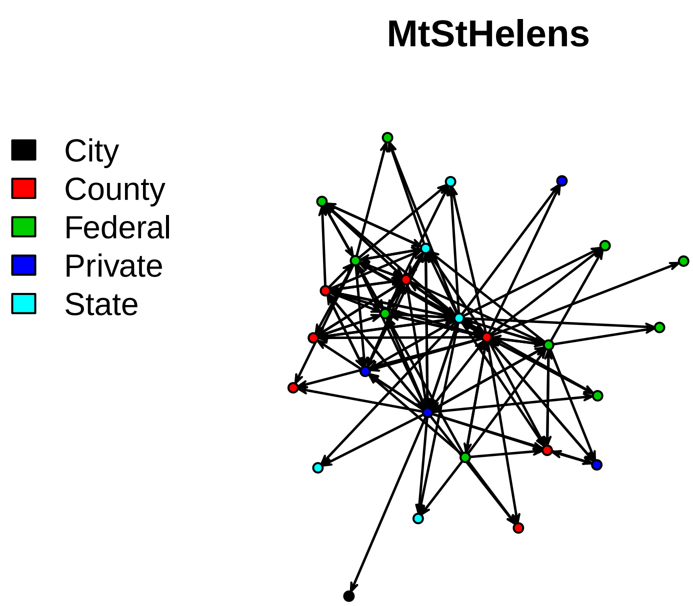
```
##   directed = TRUE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##  total edges = 123
##    missing edges = 0
##    non-missing edges = 123
##  density = 0.1752137
##
## Vertex attributes:
##
##  Command.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.000   3.000   5.000   9.118  10.000  40.000      10
##
##  Decision.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##       0       0       5       8      10      40       9
##
##  Formalization:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   1.000   1.000   1.000   1.222   1.000   3.000       9
##
##  Location:
##    character valued attribute
##    attribute summary:
##  B  L NL
##  5  9 13
##
##  Paid.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##     0.0     2.0    50.0   108.5    70.0   900.0      10
##
##  Sponsorship:
##    character valued attribute
##    attribute summary:
##    City  County Federal Private   State
##       1       7      10       4       5
##   vertex.names:
##    character valued attribute
##    27 valid vertex names
##
##  Volunteer.Staff:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
```

```
##    0.00    0.00    0.00   74.71   30.00  900.00      10
##
## Edge attributes:
##
##  Frequency:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   3.000   2.537   4.000   4.000
##
## Network edgelist matrix:
##        [,1] [,2]
##   [1,]    5    1
##   [2,]    8    1
##   [3,]    9    1
##   [4,]   12    1
##   [5,]   15    1
##   [6,]   16    1
##   [7,]   21    1
##   [8,]   22    1
##   [9,]   25    1
##  [10,]   26    1
##  [11,]   12    2
##  [12,]   15    2
##  [13,]   16    2
##  [14,]   17    2
##  [15,]   21    2
##  [16,]   26    2
##  [17,]    2    3
##  [18,]   12    3
##  [19,]   12    4
##  [20,]   15    4
##  [21,]   16    4
##  [22,]    8    5
##  [23,]    9    5
##  [24,]   12    5
##  [25,]   15    5
##  [26,]   21    5
##  [27,]   22    5
##  [28,]    5    6
##  [29,]    9    6
##  [30,]   12    6
##  [31,]    2    7
##  [32,]   12    7
##  [33,]   16    7
##  [34,]    5    8
##  [35,]    9    8
##  [36,]   12    8
##  [37,]   21    8
##  [38,]   22    8
##  [39,]    2    9
##  [40,]    5    9
##  [41,]    8    9
##  [42,]   12    9
```

```
## [43,]   15    9
## [44,]   16    9
## [45,]   21    9
## [46,]   22    9
## [47,]   12   10
## [48,]   15   10
## [49,]   12   11
## [50,]   15   11
## [51,]   26   11
## [52,]    1   12
## [53,]    2   12
## [54,]    5   12
## [55,]   15   12
## [56,]   16   12
## [57,]   21   12
## [58,]   22   12
## [59,]   25   12
## [60,]    1   13
## [61,]    5   13
## [62,]   12   13
## [63,]   16   13
## [64,]    5   14
## [65,]    9   14
## [66,]   12   14
## [67,]   15   14
## [68,]   16   14
## [69,]   22   14
## [70,]   26   14
## [71,]    2   15
## [72,]    9   15
## [73,]   12   15
## [74,]   22   15
## [75,]    1   16
## [76,]    2   16
## [77,]    5   16
## [78,]   12   16
## [79,]   15   16
## [80,]   18   16
## [81,]   21   16
## [82,]   26   16
## [83,]    2   17
## [84,]   12   17
## [85,]   15   17
## [86,]   16   17
## [87,]   18   17
## [88,]   26   17
## [89,]    2   18
## [90,]   15   18
## [91,]   16   18
## [92,]   15   19
## [93,]   16   19
## [94,]   26   19
## [95,]   12   20
## [96,]   16   20
```

```
##  [97,]    1   21
##  [98,]    5   21
##  [99,]    8   21
## [100,]    9   21
## [101,]   12   21
## [102,]   14   21
## [103,]   15   21
## [104,]   16   21
## [105,]   22   21
## [106,]   25   21
## [107,]   12   22
## [108,]   14   22
## [109,]   15   22
## [110,]   16   22
## [111,]   21   22
## [112,]    5   23
## [113,]   15   23
## [114,]   16   23
## [115,]   15   24
## [116,]    1   25
## [117,]    5   25
## [118,]   12   25
## [119,]   15   25
## [120,]   16   25
## [121,]   21   25
## [122,]   16   26
## [123,]   16   27
```

```r
plot(emon$MtStHelens, vertex.col="Sponsorship", main="MtStHelens")
vals <- sort(unique(emon$MtStHelens%v%"Sponsorship"))
legend("topleft",fill = 1:length(vals),legend=vals, bty="n")
```




```r
#Texas network
summary(emon$Texas)
```

```
## Network attributes:
##   vertices = 25
##   directed = TRUE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##  total edges = 186
##    missing edges = 0
##    non-missing edges = 186
##  density = 0.31
##
## Vertex attributes:
##
##  Command.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    1.70    3.30    5.40   10.27   15.62   30.80       7
##
##  Decision.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   2.300   5.375   8.200   9.710  11.120  32.300       5
##
##  Formalization:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    0.50    1.00    1.50    1.75    2.00    4.00       3
##
##  Location:
##    character valued attribute
##    attribute summary:
##  B  L NL
##  7 16  2
##
##  Paid.Staff:
##    integer valued attribute
##    25 values
##
##  Sponsorship:
##    character valued attribute
##    attribute summary:
##    City  County Federal Private   State
##       2      13       1       3       6
##   vertex.names:
##    character valued attribute
##    25 valid vertex names
##
##  Volunteer.Staff:
##    integer valued attribute
##    25 values
##
```

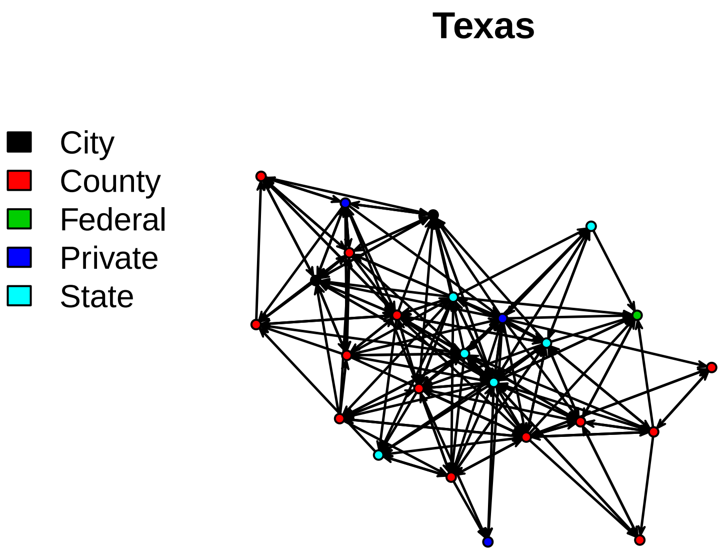
```
## Edge attributes:
##
##  Frequency:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   1.000   1.935   3.000   4.000
##
## Network edgelist matrix:
##        [,1] [,2]
##   [1,]    2    1
##   [2,]    3    1
##   [3,]    4    1
##   [4,]    5    1
##   [5,]    8    1
##   [6,]    9    1
##   [7,]   22    1
##   [8,]   23    1
##   [9,]    3    2
##  [10,]    4    2
##  [11,]    5    2
##  [12,]    6    2
##  [13,]    8    2
##  [14,]    1    3
##  [15,]    2    3
##  [16,]    4    3
##  [17,]    5    3
##  [18,]    6    3
##  [19,]    8    3
##  [20,]    9    3
##  [21,]   11    3
##  [22,]   12    3
##  [23,]   14    3
##  [24,]   15    3
##  [25,]   19    3
##  [26,]   20    3
##  [27,]   22    3
##  [28,]   23    3
##  [29,]   24    3
##  [30,]    3    4
##  [31,]    5    4
##  [32,]   12    4
##  [33,]   14    4
##  [34,]   16    4
##  [35,]    2    5
##  [36,]    3    5
##  [37,]    8    5
##  [38,]    9    5
##  [39,]   11    5
##  [40,]   14    5
##  [41,]   22    5
##  [42,]   23    5
##  [43,]    2    6
##  [44,]    3    6
```

```
## [45,]    8    6
## [46,]    9    6
## [47,]   12    6
## [48,]   13    6
## [49,]   14    6
## [50,]   16    6
## [51,]   17    6
## [52,]   23    6
## [53,]    3    7
## [54,]    4    7
## [55,]    5    7
## [56,]    9    7
## [57,]   11    7
## [58,]   12    7
## [59,]   14    7
## [60,]    2    8
## [61,]    3    8
## [62,]    4    8
## [63,]    6    8
## [64,]   11    8
## [65,]   12    8
## [66,]   16    8
## [67,]   21    8
## [68,]    3    9
## [69,]    5    9
## [70,]    8    9
## [71,]   11    9
## [72,]   12    9
## [73,]   13    9
## [74,]   14    9
## [75,]   16    9
## [76,]   22    9
## [77,]   23    9
## [78,]   25    9
## [79,]    3   10
## [80,]    8   10
## [81,]   11   10
## [82,]   12   10
## [83,]    4   11
## [84,]    5   11
## [85,]    6   11
## [86,]    7   11
## [87,]    9   11
## [88,]   12   11
## [89,]   13   11
## [90,]    3   12
## [91,]    4   12
## [92,]    5   12
## [93,]    6   12
## [94,]    9   12
## [95,]   11   12
## [96,]   13   12
## [97,]   14   12
## [98,]    3   13
```

```
##  [99,]    4   13
## [100,]    6   13
## [101,]    9   13
## [102,]   12   13
## [103,]    3   14
## [104,]    4   14
## [105,]    5   14
## [106,]    6   14
## [107,]   12   14
## [108,]   15   14
## [109,]   16   14
## [110,]   17   14
## [111,]   18   14
## [112,]   19   14
## [113,]   21   14
## [114,]    4   15
## [115,]    8   15
## [116,]   13   15
## [117,]   17   15
## [118,]   18   15
## [119,]   19   15
## [120,]   20   15
## [121,]   21   15
## [122,]    3   16
## [123,]    6   16
## [124,]   13   16
## [125,]   14   16
## [126,]   15   16
## [127,]   19   16
## [128,]   21   16
## [129,]    7   17
## [130,]   14   17
## [131,]   15   17
## [132,]   16   17
## [133,]   19   17
## [134,]   21   17
## [135,]   14   18
## [136,]   15   18
## [137,]   17   18
## [138,]   19   18
## [139,]   21   18
## [140,]    3   19
## [141,]    4   19
## [142,]    8   19
## [143,]   13   19
## [144,]   14   19
## [145,]   15   19
## [146,]   16   19
## [147,]   18   19
## [148,]   20   19
## [149,]   21   19
## [150,]    3   20
## [151,]    4   20
## [152,]    5   20
```

```
## [153,]    6   20
## [154,]    8   20
## [155,]   12   20
## [156,]   14   20
## [157,]   15   20
## [158,]   18   20
## [159,]   19   20
## [160,]   21   20
## [161,]   12   21
## [162,]   15   21
## [163,]   18   21
## [164,]   19   21
## [165,]   20   21
## [166,]    1   22
## [167,]    3   22
## [168,]    5   22
## [169,]    6   22
## [170,]    8   22
## [171,]    9   22
## [172,]   12   22
## [173,]   14   22
## [174,]   23   22
## [175,]   24   22
## [176,]    5   23
## [177,]    9   23
## [178,]   22   23
## [179,]   25   23
## [180,]    3   24
## [181,]    9   24
## [182,]   22   24
## [183,]   23   24
## [184,]    8   25
## [185,]    9   25
## [186,]   23   25
```

```r
plot(emon$Texas, vertex.col="Sponsorship", main="Texas")
vals <- sort(unique(emon$Texas%v%"Sponsorship"))
legend("topleft",fill = 1:length(vals),legend=vals, bty="n")
```




```r
#Wichita network
summary(emon$Wichita)
```

```
## Network attributes:
##   vertices = 20
##   directed = TRUE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##  total edges = 149
##    missing edges = 0
##    non-missing edges = 149
##  density = 0.3921053
##
## Vertex attributes:
##
##  Command.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    3.30    4.20    7.50   10.09   11.65   32.50       5
##
##  Decision.Rank.Score:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   0.700   3.600   7.100   9.812  12.650  31.400       4
##
##  Formalization:
##    integer valued attribute
##    20 values
##
##  Location:
##    character valued attribute
##    attribute summary:
##  B  L NL
```

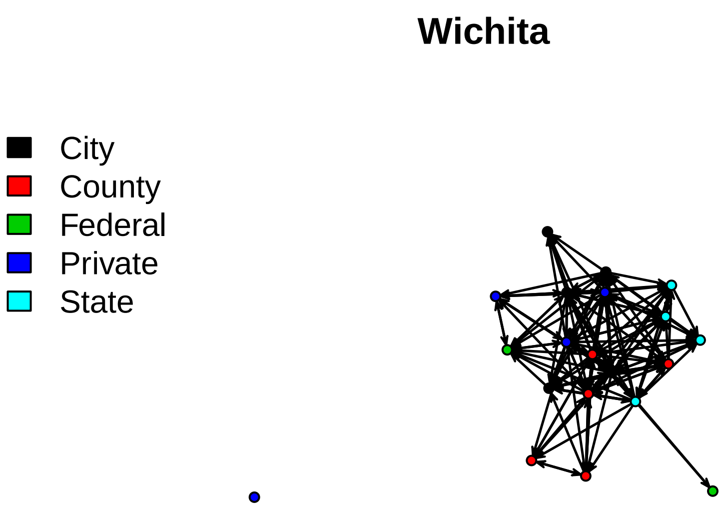
```
##   4 14  2
##
##  Paid.Staff:
##    integer valued attribute
##    20 values
##
##  Sponsorship:
##    character valued attribute
##    attribute summary:
##    City  County Federal Private   State
##       5       5       2       4       4
##   vertex.names:
##    character valued attribute
##    20 valid vertex names
##
##  Volunteer.Staff:
##    integer valued attribute
##    20 values
##
## Edge attributes:
##
##  Frequency:
##    numeric valued attribute
##    attribute summary:
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   1.000   1.000   1.651   2.000   4.000
##
## Network edgelist matrix:
##        [,1] [,2]
##   [1,]    2    1
##   [2,]    4    1
##   [3,]    5    1
##   [4,]    6    1
##   [5,]    7    1
##   [6,]    9    1
##   [7,]   10    1
##   [8,]   11    1
##   [9,]   14    1
##  [10,]   15    1
##  [11,]   17    1
##  [12,]   19    1
##  [13,]    1    2
##  [14,]    4    2
##  [15,]    5    2
##  [16,]    6    2
##  [17,]    7    2
##  [18,]   10    2
##  [19,]   15    2
##  [20,]   16    2
##  [21,]   17    2
##  [22,]   19    2
##  [23,]    1    3
##  [24,]    4    3
##  [25,]    5    3
```

```
## [26,]   15    3
## [27,]   17    3
## [28,]   19    3
## [29,]    1    4
## [30,]    5    4
## [31,]    6    4
## [32,]    9    4
## [33,]   12    4
## [34,]   14    4
## [35,]   15    4
## [36,]   17    4
## [37,]   19    4
## [38,]    1    5
## [39,]    4    5
## [40,]    7    5
## [41,]   10    5
## [42,]   11    5
## [43,]   15    5
## [44,]   17    5
## [45,]    1    6
## [46,]    7    6
## [47,]   10    6
## [48,]   15    6
## [49,]   16    6
## [50,]   17    6
## [51,]   18    6
## [52,]   19    6
## [53,]    1    7
## [54,]    4    7
## [55,]    6    7
## [56,]   10    7
## [57,]   15    7
## [58,]   17    7
## [59,]   19    7
## [60,]    1    8
## [61,]    4    8
## [62,]    5    8
## [63,]    6    8
## [64,]    7    8
## [65,]   10    8
## [66,]   15    8
## [67,]   17    8
## [68,]   19    8
## [69,]    1    9
## [70,]    2    9
## [71,]    4    9
## [72,]    5    9
## [73,]    6    9
## [74,]    7    9
## [75,]    8    9
## [76,]   10    9
## [77,]   15    9
## [78,]   17    9
## [79,]   19    9
```

```
##  [80,]    1   10
##  [81,]    2   10
##  [82,]    4   10
##  [83,]    6   10
##  [84,]    7   10
##  [85,]    8   10
##  [86,]    9   10
##  [87,]    1   11
##  [88,]    5   11
##  [89,]    6   11
##  [90,]    8   11
##  [91,]    9   11
##  [92,]   10   11
##  [93,]   15   11
##  [94,]   17   11
##  [95,]   19   11
##  [96,]    1   12
##  [97,]    2   12
##  [98,]    4   12
##  [99,]    5   12
## [100,]    6   12
## [101,]   10   12
## [102,]   14   12
## [103,]   15   12
## [104,]   17   12
## [105,]   19   12
## [106,]    1   14
## [107,]    4   14
## [108,]    5   14
## [109,]    6   14
## [110,]   12   14
## [111,]   15   14
## [112,]   19   14
## [113,]    1   15
## [114,]    4   15
## [115,]    5   15
## [116,]    6   15
## [117,]    9   15
## [118,]   12   15
## [119,]   14   15
## [120,]   17   15
## [121,]   19   15
## [122,]    1   16
## [123,]    6   16
## [124,]   10   16
## [125,]   15   16
## [126,]   17   16
## [127,]   18   16
## [128,]    1   17
## [129,]    6   17
## [130,]   10   17
## [131,]   15   17
## [132,]   16   17
## [133,]   18   17
```

```
## [134,]    1   18
## [135,]    6   18
## [136,]   10   18
## [137,]   15   18
## [138,]   16   18
## [139,]   17   18
## [140,]    1   19
## [141,]    4   19
## [142,]    6   19
## [143,]    7   19
## [144,]    9   19
## [145,]   10   19
## [146,]   14   19
## [147,]   17   19
## [148,]    1   20
## [149,]   10   20
```

```r
plot(emon$Wichita, vertex.col="Sponsorship", main="Wichita")
vals <- sort(unique(emon$Wichita%v%"Sponsorship"))
legend("topleft",fill = 1:length(vals),legend=vals, bty="n")
```



There is no selective mixing observed in the network of Cheyenne.

In the Hurricane Frederic network, homophily can be seen between the organizations at the county and city level.

There is no selective mixing observed in the network of Lake Pomona.

In the Mt. Si network, homophily can be seen between the organizations at the private level.

There is no selective mixing observed in the network of Mt. St. Helens

There is no selective mixing observed in the network of Texas network.

There is no selective mixing observed in the network of Wichita network.

(b) Dyadic Mixing Using the `mixingmatrix` command, obtain mixing matrices for all seven EMONs using "Sponsorship" as the relevant vertex attribute. For each network provide:

- The raw mixing matrix.

- The matrix of mixing rates/block densities (this was called r in class).
- The matrix of marginal z-scores, using the Poisson approximation.
- A plot of the reduced form blockmodel, with edge widths set based on mixing rates.
- A disucssion of your findings.

```
Poss_ties_matrix <- function(l){
  possible_matrix <- matrix(c(0), nrow = length(l), ncol = length(l))
for (i in 1:length(l))
{
  for(j in 1:length(l))
  {
   if(i==j)
    {
      possible_matrix[i,j] <- (l[j])*(l[j]-1)
    }
    else if(i!=j)
    {
    possible_matrix[i,j] <- (l[i])*(l[j])
    }
  }
}
  return(possible_matrix)
}

Block_density <- function(x,y)
{
 return(x/y)
}

Exp_ties_matrix <- function(obs_matrix){

matrix_temp <- matrix(c(0), nrow = nrow(obs_matrix), ncol =ncol(obs_matrix) )
x <- rowSums(obs_matrix)
y <- colSums(obs_matrix)
grand_total <- sum(obs_matrix)

for (i in 1:nrow(obs_matrix)){

   for(j in 1:ncol(obs_matrix)){


    matrix_temp[i,j] <- (x[i]*y[j])/grand_total
    }
}
 return(matrix_temp)
}

zscore <- function(y,z){
  return((y-z)/sqrt(z))
}
```

Cheyenne

```r
par(mfrow=c(1,2))
# Mixing rates/ Block Densities.
#Observed ties
Chey <- mixingmatrix(emon$Cheyenne, "Sponsorship")
Chey
```

```
##              To
## From           City County County/City Federal Private State Total
##   City            2      2           1       0       3     1     9
##   County          4      4           2       0       3     2    15
##   County/City     2      3           0       1       4     2    12
##   Federal         2      1           0       0       0     2     5
##   Private         2      4           3       0       2     2    13
##   State           6      6           3       2       6     6    29
##   Total          18     20           9       3      18    15    83
```

```r
x1<- c(get.vertex.attribute(emon[[1]], "Sponsorship"))
x1
```

```
##  [1] "State"       "State"       "State"       "Federal"     "Private"
##  [6] "Private"     "County"      "County/City" "City"        "City"
## [11] "County"      "County"      "Private"     "Private"
```

```r
x1_tab <- table(x1)
x1_tab
```

```
## x1
##        City      County County/City     Federal     Private       State
##           2           3           1           1           4           3
```

```r
#Possible ties
Chey_pos = matrix(c(0),nrow = nrow(Chey$matrix), ncol = ncol(Chey$matrix))
Chey_pos <- Poss_ties_matrix(x1_tab)
Chey_pos
```

```
##      [,1] [,2] [,3] [,4] [,5] [,6]
## [1,]    2    6    2    2    8    6
## [2,]    6    6    3    3   12    9
## [3,]    2    3    0    1    4    3
## [4,]    2    3    1    0    4    3
## [5,]    8   12    4    4   12   12
## [6,]    6    9    3    3   12    6
```

```r
BD_Chey <- Block_density(Chey$matrix,Chey_pos)
BD_Chey
```

```
##              To
## From                City    County County/City   Federal   Private
##   City        1.0000000 0.3333333   0.5000000 0.0000000 0.3750000
##   County      0.6666667 0.6666667   0.6666667 0.0000000 0.2500000
##   County/City 1.0000000 1.0000000             1.0000000 1.0000000
##   Federal     1.0000000 0.3333333   0.0000000           0.0000000
##   Private     0.2500000 0.3333333   0.7500000 0.0000000 0.1666667
##   State       1.0000000 0.6666667   1.0000000 0.6666667 0.5000000
##              To
## From               State
##   City        0.1666667
##   County      0.2222222
##   County/City 0.6666667
##   Federal     0.6666667
##   Private     0.1666667
##   State       1.0000000
```

```
gplot(BD_Chey, label = names(x1_tab))


#Marginal z scores using poisson apporoximation.

Chey_obs <- Chey$matrix

# Expected Ties
Chey_exp = matrix(c(0),nrow = nrow(Chey$matrix), ncol = ncol(Chey$matrix))
Chey_exp <- Exp_ties_matrix(Chey_obs)

Chey_exp
```

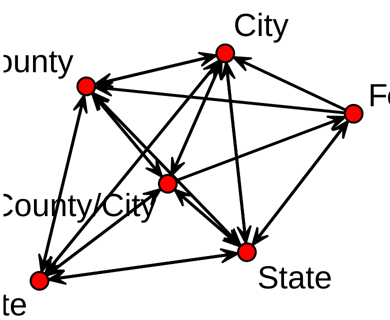
```
##          [,1]     [,2]      [,3]      [,4]     [,5]      [,6]
## [1,] 1.951807 2.168675 0.9759036 0.3253012 1.951807 1.6265060
## [2,] 3.253012 3.614458 1.6265060 0.5421687 3.253012 2.7108434
## [3,] 2.602410 2.891566 1.3012048 0.4337349 2.602410 2.1686747
## [4,] 1.084337 1.204819 0.5421687 0.1807229 1.084337 0.9036145
## [5,] 2.819277 3.132530 1.4096386 0.4698795 2.819277 2.3493976
## [6,] 6.289157 6.987952 3.1445783 1.0481928 6.289157 5.2409639
```

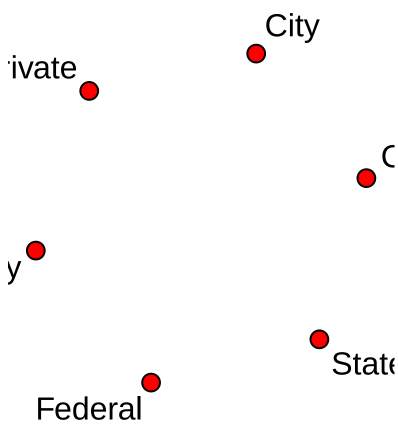
```
Chey_zscore <- zscore(Chey_obs, Chey_exp)
Chey_zscore
```

```
##              To
## From                 City      County County/City     Federal     Private
##   City         0.03449558 -0.11453883  0.02439206 -0.57035183  0.75027884
##   County       0.41416249  0.20279176  0.29285710 -0.73632104 -0.14028084
##   County/City -0.37342560  0.06376727 -1.14070365  0.85982004  0.86634738
##   Federal      0.87933284 -0.18659924 -0.73632104 -0.42511515 -1.04131520
##   Private     -0.48793496  0.49012491  1.33949764 -0.68547758 -0.48793496
##   State       -0.11530203 -0.37373245 -0.08153085  0.92966915 -0.11530203
##              To
## From                State
##   City        -0.49124417
##   County      -0.43173942
```

```
##   County/City -0.11453883
##   Federal      1.15337814
##   Private     -0.22795108
##   State        0.33155599
```

```r
gplot(abs(Chey_zscore)>2,edge.col=sign(Chey_zscore)+3,
      label=rownames(Chey_zscore),boxed.lab=FALSE,diag=TRUE)
```





Hurricane Frederic

```r
# Mixing rates/ Block Densities.
#Observed ties
HurrFred <- mixingmatrix(emon$HurrFrederic, "Sponsorship")
HurrFred
```

```
##          To
## From      City County Federal Private State Total
##   City      22     12       2       7    12    55
##   County    12     13       1       4     4    34
##   Federal    0      1       0       0     0     1
##   Private    8      4       0       0     1    13
##   State      8      5       0       1     1    15
##   Total     50     35       3      12    18   118
```

```r
x2 <- c(get.vertex.attribute(emon[[2]], "Sponsorship"))
x2
```

```
##  [1] "Federal" "State"   "State"   "State"   "County"  "County"  "County"
##  [8] "Private" "Private" "County"  "County"  "County"  "Private" "City"
## [15] "City"    "City"    "City"    "City"    "City"    "City"    "City"
```

```r
x2_tab <- table(x2)
x2_tab
```

```
## x2
##    City  County Federal Private   State
##       8       6       1       3       3
```

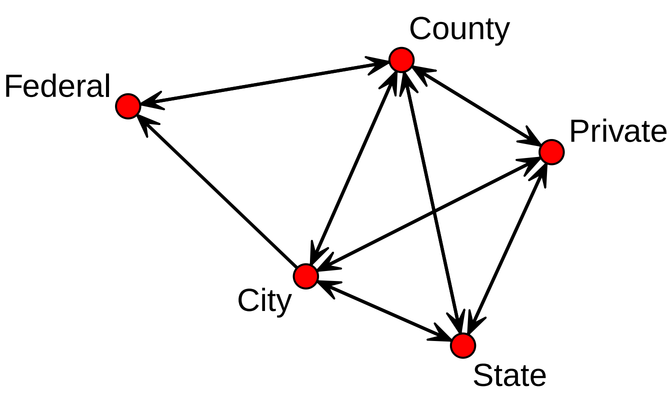
```
#Possible ties
HurrFred_pos = matrix(c(0),nrow = nrow(HurrFred$matrix), ncol = ncol(HurrFred$matrix))
HurrFred_pos <- Poss_ties_matrix(x2_tab)
HurrFred_pos
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   56   48    8   24   24
## [2,]   48   30    6   18   18
## [3,]    8    6    0    3    3
## [4,]   24   18    3    6    9
## [5,]   24   18    3    9    6
```

```
BD_HurrFred <- Block_density(HurrFred$matrix,HurrFred_pos)
BD_HurrFred
```

```
##          To
## From           City    County   Federal   Private     State
##   City    0.3928571 0.2500000 0.2500000 0.2916667 0.5000000
##   County  0.2500000 0.4333333 0.1666667 0.2222222 0.2222222
##   Federal 0.0000000 0.1666667           0.0000000 0.0000000
##   Private 0.3333333 0.2222222 0.0000000 0.0000000 0.1111111
##   State   0.3333333 0.2777778 0.0000000 0.1111111 0.1666667
```

```
gplot(BD_HurrFred,label = names(x2_tab))
```



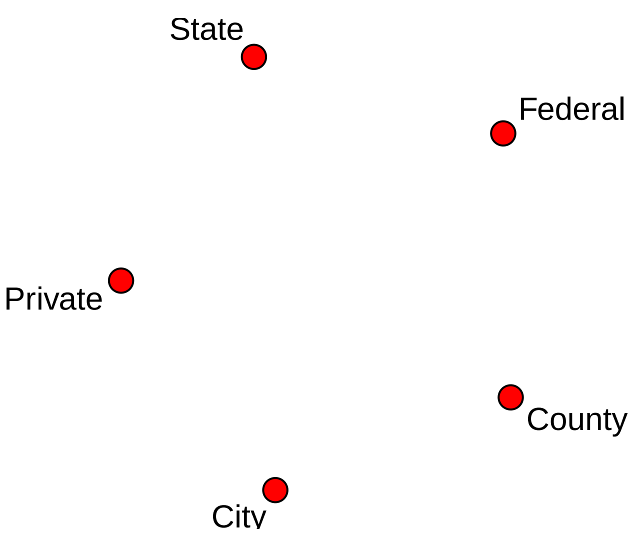

```
#Marginal z scores using poisson apporoximation.

HurrFred_obs <- HurrFred$matrix

# Expected Ties
HurrFred_exp = matrix(c(0),nrow = nrow(HurrFred$matrix), ncol = ncol(HurrFred$matrix))
HurrFred_exp <- Exp_ties_matrix(HurrFred_obs)
HurrFred_exp
```

```
##            [,1]       [,2]       [,3]      [,4]      [,5]
## [1,] 23.3050847 16.3135593 1.39830508 5.5932203 8.3898305
## [2,] 14.4067797 10.0847458 0.86440678 3.4576271 5.1864407
## [3,]  0.4237288  0.2966102 0.02542373 0.1016949 0.1525424
## [4,]  5.5084746  3.8559322 0.33050847 1.3220339 1.9830508
## [5,]  6.3559322  4.4491525 0.38135593 1.5254237 2.2881356
```

```r
HurrFred_zscore <- zscore(HurrFred_obs, HurrFred_exp)
HurrFred_zscore
```

```
##          To
## From            City      County     Federal     Private       State
##   City    -0.27034191 -1.06797580  0.50883312  0.59483309  1.24638151
##   County  -0.63409288  0.91800270  0.14584075  0.29168150 -0.52096833
##   Federal -0.65094455  1.29152574 -0.15944820 -0.31889640 -0.39056673
##   Private  1.06157247  0.07336725 -0.57489866 -1.14979733 -0.69808621
##   State    0.65212387  0.26115161 -0.61754023 -0.42541660 -0.85157068
```

```r
gplot(abs(HurrFred_zscore)>2,edge.col=sign(HurrFred_zscore)+3,
      label=rownames(HurrFred_zscore),boxed.lab=FALSE,diag=TRUE)
```



LAKE POMONA

```r
# Mixing rates/ Block Densities.
#Observed ties
LakePomona <- mixingmatrix(emon$LakePomona, "Sponsorship")
LakePomona
```

```
##          To
## From      City County Federal Private State Total
##   City       2      9       3       9    10    33
##   County     3     10       4       9    13    39
##   Federal    0      3       0       2     4     9
##   Private    3     11       4       5    11    34
##   State      2     13       4       7     7    33
##   Total     10     46      15      32    45   148
```

```r
x <- c(get.vertex.attribute(emon[[3]], "Sponsorship"))
x
```

```
##  [1] "County"  "County"  "County"  "County"  "State"   "State"   "State"
##  [8] "State"   "Federal" "Federal" "Private" "County"  "Private" "Private"
## [15] "City"    "City"    "Private" "City"    "City"    "Private"
```

```r
x_tab <- table(x)
x_tab
```

```
## x
##    City  County Federal Private   State
##       4       5       2       5       4
```

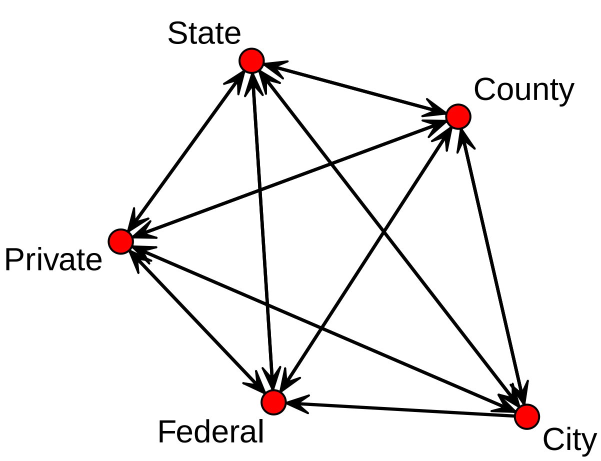
```r
#Possible ties
LakePomona_pos = matrix(c(0),nrow = nrow(LakePomona$matrix), ncol = ncol(LakePomona$matrix))
LakePomona_pos <- Poss_ties_matrix(x_tab)
LakePomona_pos
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   12   20    8   20   16
## [2,]   20   20   10   25   20
## [3,]    8   10    2   10    8
## [4,]   20   25   10   20   20
## [5,]   16   20    8   20   12
```

```r
BD_LakePomona <- Block_density(LakePomona$matrix,LakePomona_pos)
BD_LakePomona
```

```
##          To
## From           City    County   Federal   Private     State
##   City    0.1666667 0.4500000 0.3750000 0.4500000 0.6250000
##   County  0.1500000 0.5000000 0.4000000 0.3600000 0.6500000
##   Federal 0.0000000 0.3000000 0.0000000 0.2000000 0.5000000
##   Private 0.1500000 0.4400000 0.4000000 0.2500000 0.5500000
##   State   0.1250000 0.6500000 0.5000000 0.3500000 0.5833333
```

```r
gplot(BD_LakePomona, label = names(x_tab))
```



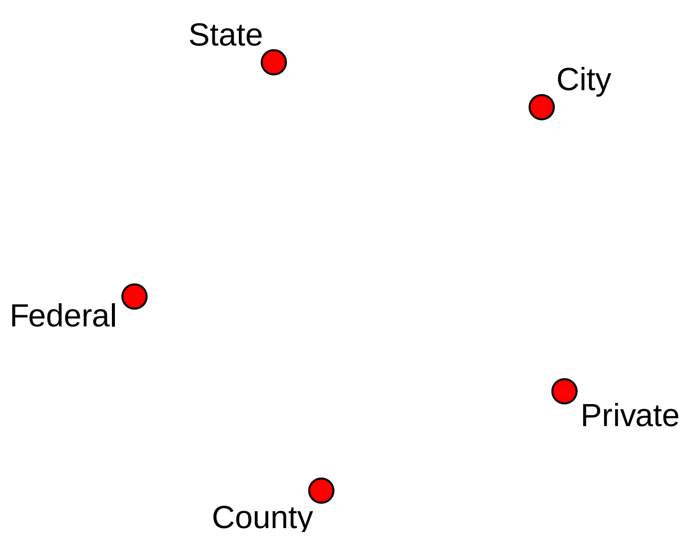
```r
#Marginal z scores using poisson apporoximation.

LakePomona_obs <- LakePomona$matrix

# Expected Ties
LakePomona_exp = matrix(c(0),nrow = nrow(LakePomona$matrix), ncol = ncol(LakePomona$matrix))
LakePomona_exp <- Exp_ties_matrix(LakePomona_obs)
LakePomona_exp
```

```
##           [,1]      [,2]      [,3]     [,4]      [,5]
## [1,] 2.2297297 10.256757 3.3445946 7.135135 10.033784
## [2,] 2.6351351 12.121622 3.9527027 8.432432 11.858108
## [3,] 0.6081081  2.797297 0.9121622 1.945946  2.736486
## [4,] 2.2972973 10.567568 3.4459459 7.351351 10.337838
## [5,] 2.2297297 10.256757 3.3445946 7.135135 10.033784
```

```r
LakePomona_zscore <- zscore(LakePomona_obs, LakePomona_exp)
LakePomona_zscore
```

```
##          To
## From             City      County     Federal     Private       State
##   City    -0.15384773 -0.39241554 -0.18842422  0.69814602 -0.01066537
##   County   0.22476599 -0.60937912  0.02378972  0.19545246  0.33160211
##   Federal -0.77981287  0.12119654 -0.95507181  0.03874921  0.76380630
##   Private  0.46362092  0.13302423  0.29846809 -0.86722929  0.20594417
##   State   -0.15384773  0.85656296  0.35837547 -0.05059029 -0.95775021
```

```r
gplot(abs(LakePomona_zscore)>2,edge.col=sign(LakePomona_zscore)+3,
      label=rownames(LakePomona_zscore),boxed.lab=FALSE,diag=TRUE)
```



MTSI

```r
# Mixing rates/ Block Densities.
#Observed ties
mtsi <- mixingmatrix(emon$MtSi, "Sponsorship")
mtsi
```

```
##          To
## From      County Federal Private State Total
##   County       0       0       4     2     6
##   Federal      0       0       0     0     0
##   Private      4       0      14     2    20
##   State        2       0       5     0     7
##   Total        6       0      23     4    33
```

```r
x <- c(get.vertex.attribute(emon[[4]], "Sponsorship"))
x
```

```
##  [1] "County"  "County"  "Private" "Private" "Private" "Private" "Private"
##  [8] "Private" "Private" "State"   "Federal" "State"   "State"
```

```r
x_tab <- table(x)
x_tab
```

```
## x
##  County Federal Private   State 
##       2       1       7       3
```

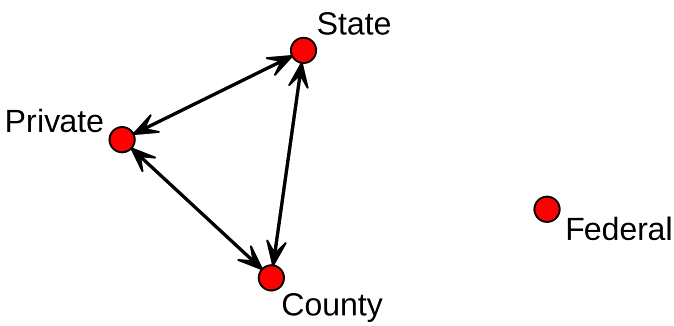
```r
#Possible ties
mtsi_pos = matrix(c(0),nrow = nrow(mtsi$matrix), ncol = ncol(mtsi$matrix))
mtsi_pos <- Poss_ties_matrix(x_tab)
mtsi_pos
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    2    2   14    6
## [2,]    2    0    7    3
## [3,]   14    7   42   21
## [4,]    6    3   21    6
```

```r
BD_mtsi <- Block_density(mtsi$matrix,mtsi_pos)
BD_mtsi
```

```
##          To
## From         County   Federal   Private     State
##   County  0.0000000 0.0000000 0.2857143 0.3333333
##   Federal 0.0000000           0.0000000 0.0000000
##   Private 0.2857143 0.0000000 0.3333333 0.0952381
##   State   0.3333333 0.0000000 0.2380952 0.0000000
```

```r
gplot(BD_mtsi, label = names(x_tab))
```



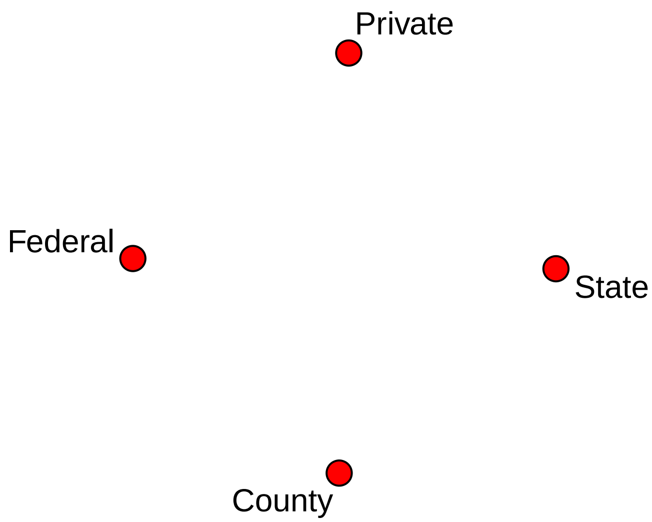

```
#Marginal z scores using poisson apporoximation.

mtsi_obs <- mtsi$matrix

# Expected Ties
mtsi_exp = matrix(c(0),nrow = nrow(mtsi$matrix), ncol = ncol(mtsi$matrix))
mtsi_exp <- Exp_ties_matrix(mtsi_obs)
mtsi_exp
```

```
##          [,1] [,2]      [,3]      [,4]
## [1,] 1.090909    0  4.181818 0.7272727
## [2,] 0.000000    0  0.000000 0.0000000
## [3,] 3.636364    0 13.939394 2.4242424
## [4,] 1.272727    0  4.878788 0.8484848
```

```
mtsi_zscore <- zscore(mtsi_obs, mtsi_exp)
mtsi_zscore
```

```
##          To
## From           County Federal     Private       State
##   County  -1.04446594         -0.08891084  1.49240501
##   Federal
##   Private  0.19069252          0.01623283 -0.27247463
##   State    0.64465837          0.05487696 -0.92113237
```

```
gplot(abs(mtsi_zscore)>2,edge.col=sign(mtsi_zscore)+3,
      label=rownames(mtsi_zscore),boxed.lab=FALSE,diag=TRUE)
```



MTST Helens

```
# Mixing rates/ Block Densities.
#Observed ties
mt_helens <- mixingmatrix(emon$MtStHelens, "Sponsorship")
mt_helens
```

```
##          To
## From      City County Federal Private State Total
##   City       0      0       0       0     0     0
##   County     0     11      15       5     8    39
##   Federal    0     13       9       4     9    35
##   Private    1     11       4       2     4    22
##   State      0      6      12       5     4    27
##   Total      1     41      40      16    25   123
```

```
x <- c(get.vertex.attribute(emon[[5]], "Sponsorship"))
x
```

```
##  [1] "Federal" "Federal" "Federal" "Federal" "Federal" "Federal" "Federal"
##  [8] "Federal" "State"   "State"   "State"   "State"   "State"   "Private"
## [15] "Private" "County"  "County"  "Private" "County"  "Private" "County"
## [22] "County"  "County"  "City"    "County"  "Federal" "Federal"
```

```
x_tab <- table(x)
x_tab
```

```
## x
##    City  County Federal Private   State
##       1       7      10       4       5
```

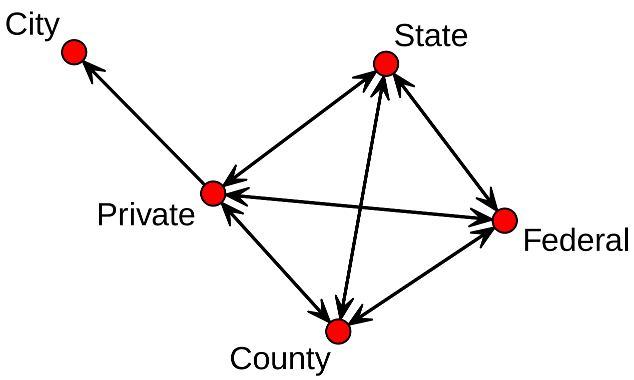
```r
#Possible ties
mt_helens_pos = matrix(c(0),nrow = nrow(mt_helens$matrix), ncol = ncol(mt_helens$matrix))
mt_helens_pos <- Poss_ties_matrix(x_tab)
mt_helens_pos
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    0    7   10    4    5
## [2,]    7   42   70   28   35
## [3,]   10   70   90   40   50
## [4,]    4   28   40   12   20
## [5,]    5   35   50   20   20
```

```r
BD_mt_helens <- Block_density(mt_helens$matrix,mt_helens_pos)
BD_mt_helens
```

```
##          To
## From           City    County   Federal   Private     State
##   City                0.0000000 0.0000000 0.0000000 0.0000000
##   County  0.0000000 0.2619048 0.2142857 0.1785714 0.2285714
##   Federal 0.0000000 0.1857143 0.1000000 0.1000000 0.1800000
##   Private 0.2500000 0.3928571 0.1000000 0.1666667 0.2000000
##   State   0.0000000 0.1714286 0.2400000 0.2500000 0.2000000
```

```r
gplot(BD_mt_helens, label = names(x_tab))
```



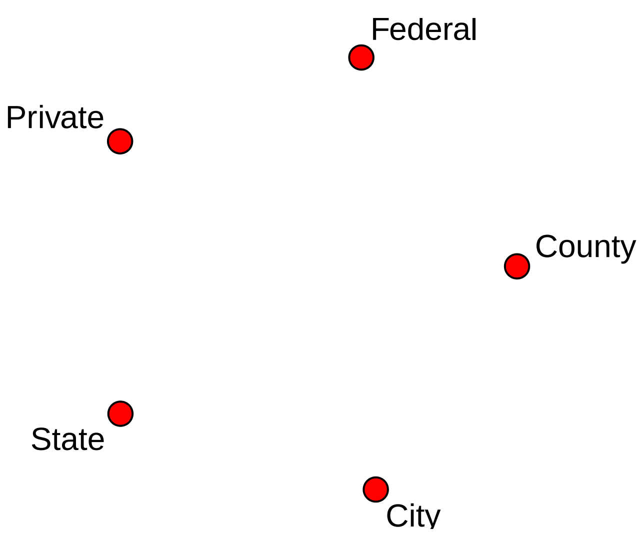

```r
#Marginal z scores using poisson apporoximation.

mt_helens_obs <- mt_helens$matrix

# Expected Ties
mt_helens_exp = matrix(c(0),nrow = nrow(mt_helens$matrix), ncol = ncol(mt_helens$matrix))
mt_helens_exp <- Exp_ties_matrix(mt_helens_obs)
mt_helens_exp
```

```
##           [,1]      [,2]      [,3]     [,4]     [,5]
## [1,] 0.0000000  0.000000  0.000000 0.000000 0.000000
## [2,] 0.3170732 13.000000 12.682927 5.073171 7.926829
## [3,] 0.2845528 11.666667 11.382114 4.552846 7.113821
## [4,] 0.1788618  7.333333  7.154472 2.861789 4.471545
## [5,] 0.2195122  9.000000  8.780488 3.512195 5.487805
```

```r
mt_helens_zscore <- zscore(mt_helens_obs, mt_helens_exp)
mt_helens_zscore
```

```
##          To
## From             City      County     Federal     Private       State
##   City
##   County  -0.56309251 -0.55470020  0.65062389 -0.03248611  0.02598888
##   Federal -0.53343495  0.39036003 -0.70607534 -0.25909698  0.70718233
##   Private  1.94158978  1.35400640 -1.17933675 -0.50942702 -0.22299447
##   State   -0.46852129 -1.00000000  1.08650256  0.79388329 -0.63510663
```

```r
gplot(abs(mt_helens_zscore)>2,edge.col=sign(mt_helens_zscore)+3,
      label=rownames(mt_helens_zscore),boxed.lab=FALSE,diag=TRUE)
```



Texas Hill

```r
# Mixing rates/ Block Densities.
#Observed ties
texas <- mixingmatrix(emon$Texas, "Sponsorship")
texas
```

```
##          To
## From      City County Federal Private State Total
##   City       2      6       0       2     2    12
##   County     9     47       3       8    27    94
##   Federal    0      1       0       0     1     2
##   Private    4      9       1       2     4    20
##   State      6     26       4       5    17    58
##   Total     21     89       8      17    51   186
```

```r
x <- c(get.vertex.attribute(emon[[6]], "Sponsorship"))
x
```

```
##  [1] "Federal" "State"   "State"   "State"   "State"   "State"   "State"
##  [8] "Private" "County"  "Private" "County"  "County"  "County"  "County"
## [15] "County"  "County"  "County"  "County"  "City"    "City"    "Private"
## [22] "County"  "County"  "County"  "County"
```

```r
x_tab <- table(x)
x_tab
```

```
## x
##    City  County Federal Private   State
##       2      13       1       3       6
```

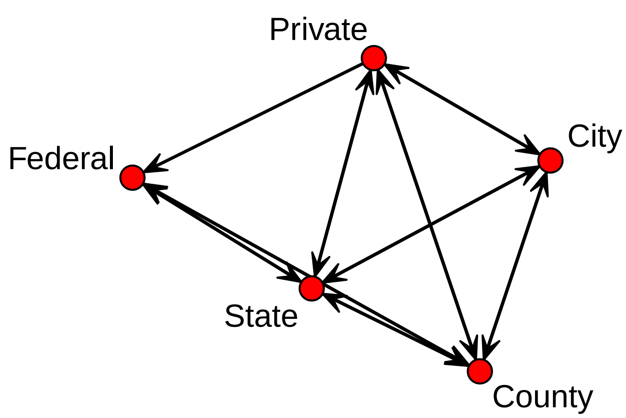
```r
#Possible ties
texas_pos = matrix(c(0),nrow = nrow(texas$matrix), ncol = ncol(texas$matrix))
texas_pos <- Poss_ties_matrix(x_tab)
texas_pos
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    2   26    2    6   12
## [2,]   26  156   13   39   78
## [3,]    2   13    0    3    6
## [4,]    6   39    3    6   18
## [5,]   12   78    6   18   30
```

```r
BD_texas <- Block_density(texas$matrix,texas_pos)
BD_texas
```

```
##          To
## From            City     County    Federal    Private      State
##   City    1.00000000 0.23076923 0.00000000 0.33333333 0.16666667
##   County  0.34615385 0.30128205 0.23076923 0.20512821 0.34615385
##   Federal 0.00000000 0.07692308            0.00000000 0.16666667
##   Private 0.66666667 0.23076923 0.33333333 0.33333333 0.22222222
##   State   0.50000000 0.33333333 0.66666667 0.27777778 0.56666667
```

```r
gplot(BD_texas, label = names(x_tab))
```



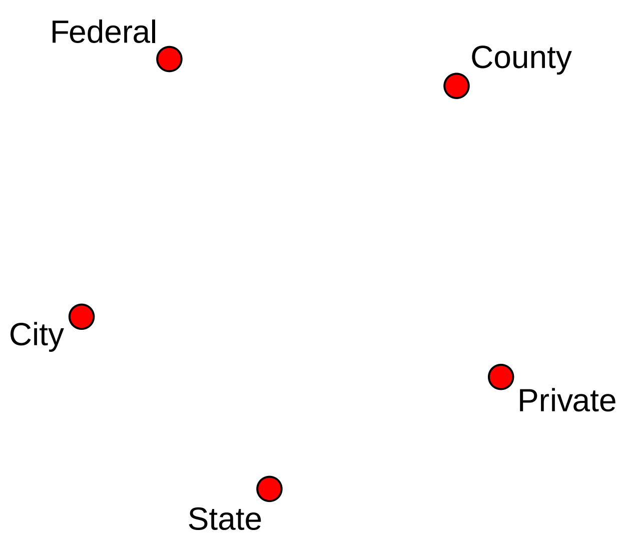
```r
#Marginal z scores using poisson apporoximation.

texas_obs <- texas$matrix

# Expected Ties
texas_exp = matrix(c(0),nrow = nrow(texas$matrix), ncol = ncol(texas$matrix))
texas_exp <- Exp_ties_matrix(texas_obs)
texas_exp
```

```
##            [,1]       [,2]       [,3]      [,4]       [,5]
## [1,]  1.3548387  5.7419355 0.51612903 1.0967742  3.2903226
## [2,] 10.6129032 44.9784946 4.04301075 8.5913978 25.7741935
## [3,]  0.2258065  0.9569892 0.08602151 0.1827957  0.5483871
## [4,]  2.2580645  9.5698925 0.86021505 1.8279570  5.4838710
## [5,]  6.5483871 27.7526882 2.49462366 5.3010753 15.9032258
```

```r
texas_zscore <- zscore(texas_obs, texas_exp)
texas_zscore
```

```
##          To
## From             City      County     Federal     Private       State
##   City     0.55427400  0.10769589 -0.71842121  0.86245755 -0.71134299
##   County  -0.49509804  0.30142026 -0.51872399 -0.20176593  0.24145120
##   Federal -0.47519096  0.04396666 -0.29329423 -0.42754614  0.60984958
##   Private  1.15921474 -0.18422111  0.15071514  0.12724890 -0.63365450
##   State   -0.21429896 -0.33269948  0.95310900 -0.13076548  0.27502654
```

```r
gplot(abs(texas_zscore)>2,edge.col=sign(texas_zscore)+3,
      label=rownames(texas_zscore),boxed.lab=FALSE,diag=TRUE)
```



Wichita Falls

```r
# Mixing rates/ Block Densities.
#Observed ties
wichita <- mixingmatrix(emon$Wichita, "Sponsorship")
wichita
```

```
##          To
## From      City County Federal Private State Total
##   City      13      6       5       8    12    44
##   County    12     15       2       6    10    45
##   Federal    1      0       0       2     0     3
##   Private   11      7       3       5     6    32
##   State      7      5       2       3     8    25
##   Total     44     33      12      24    36   149
```

```r
x <- c(get.vertex.attribute(emon[[7]], "Sponsorship"))
x
```

```
##  [1] "City"    "City"    "City"    "City"    "City"    "County"  "County"
##  [8] "State"   "State"   "State"   "State"   "Federal" "Private" "Private"
## [15] "Private" "County"  "County"  "County"  "Private" "Federal"
```

```r
x_tab <- table(x)
x_tab
```

```
## x
##    City  County Federal Private   State
##       5       5       2       4       4
```

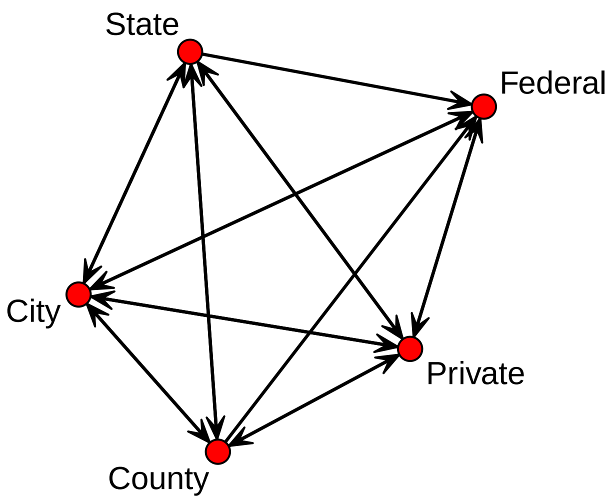
```r
#Possible ties
wichita_pos = matrix(c(0),nrow = nrow(wichita$matrix), ncol = ncol(wichita$matrix))
wichita_pos <- Poss_ties_matrix(x_tab)
wichita_pos
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   20   25   10   20   20
## [2,]   25   20   10   20   20
## [3,]   10   10    2    8    8
## [4,]   20   20    8   12   16
## [5,]   20   20    8   16   12
```

```r
BD_wichita <- Block_density(wichita$matrix,wichita_pos)
BD_wichita
```

```
##          To
## From           City    County   Federal   Private     State
##   City    0.6500000 0.2400000 0.5000000 0.4000000 0.6000000
##   County  0.4800000 0.7500000 0.2000000 0.3000000 0.5000000
##   Federal 0.1000000 0.0000000 0.0000000 0.2500000 0.0000000
##   Private 0.5500000 0.3500000 0.3750000 0.4166667 0.3750000
##   State   0.3500000 0.2500000 0.2500000 0.1875000 0.6666667
```

```r
gplot(BD_wichita, label = names(x_tab))
```



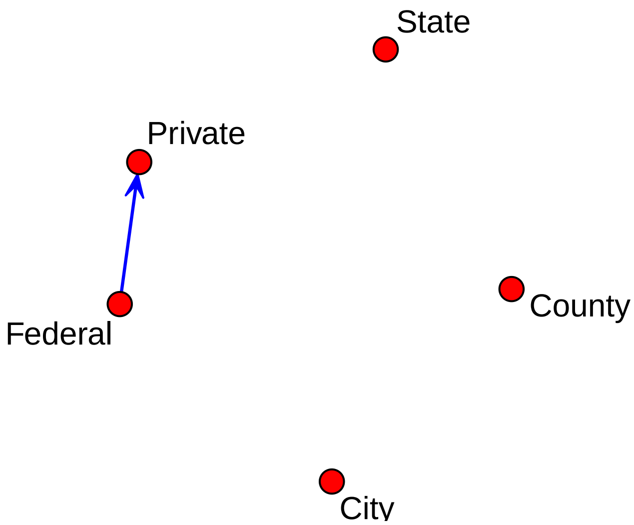

```r
#Marginal z scores using poisson apporoximation.

wichita_obs <- wichita$matrix

# Expected Ties
wichita_exp = matrix(c(0),nrow = nrow(wichita$matrix), ncol = ncol(wichita$matrix))
wichita_exp <- Exp_ties_matrix(wichita_obs)
wichita_exp
```

```
##           [,1]      [,2]      [,3]      [,4]       [,5]
## [1,] 12.993289 9.7449664 3.5436242 7.0872483 10.6308725
## [2,] 13.288591 9.9664430 3.6241611 7.2483221 10.8724832
## [3,]  0.885906 0.6644295 0.2416107 0.4832215  0.7248322
## [4,]  9.449664 7.0872483 2.5771812 5.1543624  7.7315436
## [5,]  7.382550 5.5369128 2.0134228 4.0268456  6.0402685
```

```r
wichita_zscore <- zscore(wichita_obs, wichita_exp)
wichita_zscore
```

```
##          To
## From              City       County      Federal      Private        State
##   City     0.001861891 -1.199658834  0.773659100  0.342857627  0.419913120
##   County  -0.353488671  1.594427963 -0.853149915 -0.463668863 -0.264601749
##   Federal  0.121218477 -0.815125469 -0.491539152  2.181971415 -0.851370786
##   Private  0.504333153 -0.032773156  0.263379399 -0.067991417 -0.622730780
##   State   -0.140794399 -0.228175956 -0.009459675 -0.511708547  0.797385736
```

```r
gplot(abs(wichita_zscore)>2,edge.col=sign(wichita_zscore)+3,
      label=rownames(wichita_zscore),boxed.lab=FALSE,diag=TRUE)
```



1.Considering a threshold of 0.5, the block densities/ mixing rates of networks that are geater than the threshold indicate that there is a greater tie probability between them. For eg: the block density between state and federal(0.67) in the Cheyenne network show that there is a good interaction between the organizations at these two levels.

2.The z score calculated for the Wichita network shows significant departure from the normal distribution of interaction, that can been seen on the basis of the sponsorship attribute between organizations. This may imply that the interaction between the organizations at the federal and private levels are not ordinary.

3.When we the plot the graph for the reduced Block model, which basically show the z score values calculated for the interaction between organizations at various levels, wichita is the only network , where the z score between the federal and private levels crosses the 2 deviation mark.

(c) Discussion Based on your analysis in parts (a)-(b) how would you describe the overall pattern of communication mixing in the Drabek et al. SAR EMONs?

From the plots for the network, few cases of selective mixing or homophily can be seen. Rest of them are heterogeneous networks with interactions between organizations at various levels. From general visulaization the Hurrican Frederic network and the Mt. Si network show homophily to some extent. There is no significant selective mixing seen in the other networks. There is an unusual interaction between organizations at the private and federal seen in the Wichita network.