

Package ‘tnet’

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Title tnet: Software for Analysis of Weighted, Two-mode, and Longitudinal networks

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Suggests network, sna, statnet

Description R package to analyse weighted, two-mode, and longitudinal networks.

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tnet-package	<i>Collection of function for analysing weighted networks, two-mode networks, and longitudinal networks</i>
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Description

This package can analyse weighted networks, two-mode networks, and longitudinal networks. Binary ties limit the richness of networks as all relations are unique. The two-mode structure contains a number of features lost when projection it to a one-mode network. Longitudinal datasets allow for an understanding of the causal relationship among ties, which is not the case in cross-sectional datasets as ties depend on each other.

Details

Package:	tnet
Type:	Package
Version:	0.1.1
Date:	2009-07-01

This package allows for analysis of weighted network, two-mode network, and longitudinal network datasets. More information is available on <http://opsahl.co.uk/tnet/> and <http://toreopsahl.com>

It reads three forms of data structures:

1) simple weighted data in the following format (vertex.id.of.creator vertex.id.of.target weight.of.tie):

```
1 2 4  
1 3 2
```

2) two-mode data in the following format (vertex.id.of.node.in.set.1 vertex.id.of.node.in.set.2 optional.weight.of.tie):

```
1 1 1  
2 1 2
```

3) timed data in the following format (MySQL-timestamp.surrounded.by.quotes vertex.id.of.creator vertex.id.of.target weight):

```
"2007-09-12 13:45:00" 1 2 1  
"2007-09-12 13:46:31" 1 2 1
```

If ties are repeated, the tie increases the weighted. The weight column decides how much weight is added at each time (this can take a negative value to decrease the weight).

Attribute files are read as follows:

```
0 1 3  
0 3 2  
1 3 3
```

where the first row refers to vertex id 1, the second row to vertex id 2, and so on. The first column refers to the first attributes, second column to the second attribute and so on.

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://opsahl.co.uk/tnet/>

Examples

```
# Generate a random weighted graph  
rg <- rg_w(nodes=100,arcs=300,directed=TRUE)  
  
# Calculate clustering coefficient  
clustering_w(rg)
```

`as.tnet`*Ensures that networks conform to the tnet standards*

Description

Checks the networks and attaches a label. If the type parameter is not set, the network is assumed to be a binary two-mode network, a weighted one-mode network, or a longitudinal network if there are 2, 3, or 4 columns respectively.

Usage

```
as.tnet(net, type=NULL)
```

Arguments

<code>net</code>	A network in an edgelist. It can be a weighted one-mode network, a binary two-mode network, a weighted two-mode network, or a longitudinal network.
<code>type</code>	If you would like to specify the type of network. This could be "weighted one-mode tnet", "binary two-mode tnet", "weighted two-mode tnet", or "longitudinal tnet".

Value

Returns the network with an attached label.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

Examples

```
## Load sample data
sample <- rbind(
  c(1,2,4),
  c(1,3,2),
  c(2,1,4),
  c(2,3,4),
  c(2,4,1),
  c(2,5,2),
  c(3,1,2),
  c(3,2,4),
  c(4,2,1),
  c(5,2,2),
  c(5,6,1),
  c(6,5,1))
```

```
## Run the programme  
as.tnet(sample)
```

betweenness_w *Betweenness centrality in a weighted network*

Description

This function calculates betweenness scores for nodes in a weighted network based on the distance_w.

Note: This algorithm relies on the RBGL package's implementation of the boost C++-library. This implementation includes Brandes' (2001) algorithm, and finds multiple paths if they have exactly the same distance. For example, if one path is found over the direct tie with a weight of 1 (distance = $1/1 = 1$) and a second path is through an intermediary node with two ties with weights of 2 (distance = $1/2 + 1/2 = 1$), the two paths have exactly the same distance. However, if there is a third path through two intermediaries with three ties with weights of 3 (distance = $1/3 + 1/3 + 1/3$), computers read these values as 0.3333333 and the sum of these values is 0.9999999. Thus, it is not exactly equal to the distance of the other two paths. In fact, this path is considered shorter than the others ($0.9999999 < 1$).

Usage

```
betweenness_w(net, directed=NULL)
```

Arguments

net	A weighted edgelist
directed	logical, whether the network is directed or undirected. Default is NULL, this means that the function checks whether the edgelist is directed or not.

Value

Returns a data.frame with two columns: the first contains the node ids of all the nodes in the edgelist, and the second contains the corresponding betweenness scores.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2009/02/20/betweenness-in-weighted-networks/>

Examples

```
## Load sample data
sampledata <- rbind(
  c(1,2,1),
  c(1,3,5),
  c(2,1,1),
  c(2,4,6),
  c(3,1,5),
  c(3,4,10),
  c(4,2,6),
  c(4,3,10))

## Run the programme
betweenness_w(sampledata)
```

celegans.n306.net *The neural network of the Caenorhabditis elegans worm (C.elegans)*

Description

This dataset contains the neural network of the *Caenorhabditis elegans* worm (*C.elegans*). It was studied by Watts and Strogatz (1998). The network contains 306 nodes that represent neurons. Two neurons are connected if at least one synapse or gap junction exist between them. The weight is the number of synapses and gap junctions. This network was obtained from the Collective Dynamics Group's website.

Usage

```
celegans.n306
```

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Watts, D. J., Strogatz, S. H., 1998. Collective dynamics of "small-world" networks. *Nature* 393, 440-442.
<http://toreopsahl.com/datasets/>

`closeness_w` *Closeness centrality in a weighted network*

Description

This function calculates closeness scores for nodes in a weighted network based on the `distance_w`.

Usage

```
closeness_w(net, directed=NULL, precomp.dist=NULL)
```

Arguments

<code>net</code>	A weighted edgelist
<code>directed</code>	Logical: whether the edgelist is directed or undirected. Default is NULL, then the function detects this parameter.
<code>precomp.dist</code>	If you have already computed the distance matrix using <code>distance_w</code> , you can enter the name of the matrix object here.

Value

Returns a data.frame with two columns: the first contains the node ids of all the nodes in the edgelist, and the second contains the corresponding closeness scores.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2009/01/09/average-shortest-distance-in-weighted-networks/>

Examples

```
## Load sample data
sampledata <- rbind(
  c(1,2,4),
  c(1,3,2),
  c(2,1,4),
  c(2,3,4),
  c(2,4,1),
  c(2,5,2),
  c(3,1,2),
  c(3,2,4),
```

```
c(4, 2, 1),  
c(5, 2, 2),  
c(5, 6, 1),  
c(6, 5, 1))  
  
## Run the programme  
closeness_w(sampledata)
```

clustering_tm

Redefined clustering coefficient for two-mode networks

Description

This function calculates the two-mode clustering coefficient as proposed by Opsahl, T., 2009. Clustering in binary and weighted two-mode networks. Two-mode conference in Amsterdam.

Usage

```
clustering_tm(net)
```

Arguments

net A binary or weighted two-mode edgelist

Value

Returns the outcome of the equation presented in the paper

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Opsahl, T., 2009. Clustering in binary and weighted two-mode networks. Two-mode conference in Amsterdam.

Examples

```
# Weighted two-mode network
net <- cbind(
  i=c(1,1,2,2,2,3,3,4,5,5,6),
  p=c(1,2,1,3,4,2,3,4,3,5,5),
  w=c(3,5,6,1,2,6,2,1,3,1,2))

## Run binary clustering function
clustering_tm(net[,1:2])

## Run weighted clustering function
clustering_tm(net)
```

clustering_w	<i>Generalised clusering coefficient</i>
--------------	--

Description

This function calculates the generalised clusering coefficient as proposed by Opsahl, T., Panzarasa, P., 2009. Clustering in weighted networks. Social Networks 31 (2), 155-163, doi: 10.1016/j.socnet.2009.02.002

Usage

```
clustering_w(net, measure = "mi")
```

Arguments

net	A weighted edgelist
measure	The measure-switch control the method used to calculate the value of the triplets. am implies the arithmetic mean method gm implies the geometric mean method mi implies the minimum method ma implies the maximum method This can be c("am", "gm", "mi", "ma") to calculate all.

Value

Returns the outcome of the equation presented in the paper for the method specific (measure)

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Opsahl, T., Panzarasa, P., 2009. Clustering in weighted networks. *Social Networks* 31 (2), 155-163, doi: 10.1016/j.socnet.2009.02.002
<http://toreopsahl.com/2009/04/03/article-clustering-in-weighted-networks/>

Examples

```
## Generate a random graph
#density: 300/(100*99)=0.03030303;
#this should be average from random samples
rg <- rg_w(nodes=100,arcs=300,max.weight=10)

## Run clustering function
clustering_w(rg)
```

clustering_w_barrat

Barrat et al. (2004) generalised local clustering coefficient

Description

This function calculates Barrat et al. (2004) generalised local clustering coefficient. See <http://toreopsahl.com/2009/01/23/weighted-local-clustering-coefficient/> for a detailed description. By default it measure the triplet value as the average of the two ties; however it can also define it differently. See the blog post.

Usage

```
clustering_w_barrat(net, measure = "am")
```

Arguments

net	A weighted edgelist
measure	The measure-switch control the method used to calculate the value of the triplets. am implies the arithmetic mean method gm implies the geometric mean method mi implies the minimum method ma implies the maximum method This can be c("am", "gm", "mi", "ma") to calculate all.

Value

Returns a data.frame with at least two columns: the first contains the node ids of all the nodes in the edgelist, and the remaining ones contain the corresponding clustering scores.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Barrat, A., Barthelemy, M., Pastor-Satorras, R., Vespignani, A., 2004. The architecture of complex weighted networks. *Proceedings of the National Academy of Sciences* 101 (11), 3747-3752. arXiv:cond-mat/0311416
<http://toreopsahl.com/2009/01/23/weighted-local-clustering-coefficient/>

Examples

```
## Generate a random graph
#density: 300/(100*99)=0.03030303;
#this should be average from random samples
rg <- rg_w(nodes=100,arcs=300,max.weight=10,directed=FALSE)

## Run clustering function
clustering_w_barrat(rg)
```

Cross.Parker.Consulting.net.info
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a consulting company (46 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties are differentiated on a scale from 0 to 5 in terms of frequency of information or advice requests ("Please indicate how often you have turned to this person for information or advice on work-related topics in the past three months"). 0: I Do Not Know This Person; 1: Never; 2: Seldom; 3: Sometimes; 4: Often; and 5:Very Often.

In the second network, ties are differentiated in terms of the value placed on the information or advice received ("For each person in the list below, please show how strongly you agree or disagree with the following statement: In general, this person has expertise in areas that are important in the kind of work I do."). The weights in this network is also based on a scale from 0 to 5. 0: I Do Not Know This Person; 1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; and 5: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: the organisational level (1 Research Assistant; 2:

Junior Consultant; 3: Senior Consultant; 4: Managing Consultant; 5: Partner), gender (1: male; 2: female), region (1: Europe; 2: USA), and location (1: Boston; 2: London; 3: Paris; 4: Rome; 5: Madrid; 6: Oslo; 7: Copenhagen).

See <http://toreopsahl.com/datasets/>

Usage

```
Cross.Parker.Consulting.net.info
```

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

```
Cross.Parker.Consulting.net.value
```

Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a consulting company (46 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties are differentiated on a scale from 0 to 5 in terms of frequency of information or advice requests ("Please indicate how often you have turned to this person for information or advice on work-related topics in the past three months"). 0: I Do Not Know This Person; 1: Never; 2: Seldom; 3: Sometimes; 4: Often; and 5:Very Often.

In the second network, ties are differentiated in terms of the value placed on the information or advice received ("For each person in the list below, please show how strongly you agree or disagree with the following statement: In general, this person has expertise in areas that are important in the kind of work I do."). The weights in this network is also based on a scale from 0 to 5. 0: I Do Not Know This Person; 1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; and 5: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: the organisational level (1 Research Assistant; 2: Junior Consultant; 3: Senior Consultant; 4: Managing Consultant; 5: Partner), gender (1: male; 2: female), region (1: Europe; 2: USA), and location (1: Boston; 2: London; 3: Paris; 4: Rome; 5: Madrid; 6: Oslo; 7: Copenhagen).

See <http://toreopsahl.com/datasets/>

Usage

```
Cross.Parker.Consulting.net.value
```

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

```
Cross.Parker.Consulting.node.gender
```

Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a consulting company (46 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties are differentiated on a scale from 0 to 5 in terms of frequency of information or advice requests ("Please indicate how often you have turned to this person for information or advice on work-related topics in the past three months"). 0: I Do Not Know This Person; 1: Never; 2: Seldom; 3: Sometimes; 4: Often; and 5:Very Often.

In the second network, ties are differentiated in terms of the value placed on the information or advice received ("For each person in the list below, please show how strongly you agree or disagree with the following statement: In general, this person has expertise in areas that are important in the kind of work I do."). The weights in this network is also based on a scale from 0 to 5. 0: I Do Not Know This Person; 1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; and 5: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: the organisational level (1 Research Assistant; 2: Junior Consultant; 3: Senior Consultant; 4: Managing Consultant; 5: Partner), gender (1: male; 2: female), region (1: Europe; 2: USA), and location (1: Boston; 2: London; 3: Paris; 4: Rome; 5: Madrid; 6: Oslo; 7: Copenhagen).

See <http://toreopsahl.com/datasets/>

Usage

```
Cross.Parker.Consulting.node.gender
```

Format

A vector with nodal attribute.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

Cross.Parker.Consulting.node.location
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a consulting company (46 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties are differentiated on a scale from 0 to 5 in terms of frequency of information or advice requests ("Please indicate how often you have turned to this person for information or advice on work-related topics in the past three months"). 0: I Do Not Know This Person; 1: Never; 2: Seldom; 3: Sometimes; 4: Often; and 5:Very Often.

In the second network, ties are differentiated in terms of the value placed on the information or advice received ("For each person in the list below, please show how strongly you agree or disagree with the following statement: In general, this person has expertise in areas that are important in the kind of work I do."). The weights in this network is also based on a scale from 0 to 5. 0: I Do Not Know This Person; 1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; and 5: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: the organisational level (1 Research Assistant; 2: Junior Consultant; 3: Senior Consultant; 4: Managing Consultant; 5: Partner), gender (1: male; 2: female), region (1: Europe; 2: USA), and location (1: Boston; 2: London; 3: Paris; 4: Rome; 5: Madrid; 6: Oslo; 7: Copenhagen).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Consulting.node.location

Format

A vector with nodal attribute.

References

Cross, R., Parker, A., 2004. *The Hidden Power of Social Networks*. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

Cross.Parker.Consulting.node.orglevel
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a consulting company (46 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties are differentiated on a scale from 0 to 5 in terms of frequency of information or advice requests ("Please indicate how often you have turned to this person for information or advice on work-related topics in the past three months"). 0: I Do Not Know This Person; 1: Never; 2: Seldom; 3: Sometimes; 4: Often; and 5:Very Often.

In the second network, ties are differentiated in terms of the value placed on the information or advice received ("For each person in the list below, please show how strongly you agree or disagree with the following statement: In general, this person has expertise in areas that are important in the kind of work I do."). The weights in this network is also based on a scale from 0 to 5. 0: I Do Not Know This Person; 1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; and 5: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: the organisational level (1 Research Assistant; 2: Junior Consultant; 3: Senior Consultant; 4: Managing Consultant; 5: Partner), gender (1: male; 2: female), region (1: Europe; 2: USA), and location (1: Boston; 2: London; 3: Paris; 4: Rome; 5: Madrid; 6: Oslo; 7: Copenhagen).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Consulting.node.orglevel

Format

A vector with nodal attribute.

References

Cross, R., Parker, A., 2004. *The Hidden Power of Social Networks*. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

Cross.Parker.Consulting.node.region
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a consulting company (46 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties are differentiated on a scale from 0 to 5 in terms of frequency of information or advice requests ("Please indicate how often you have turned to this person for information or advice on work-related topics in the past three months"). 0: I Do Not Know This Person; 1: Never; 2: Seldom; 3: Sometimes; 4: Often; and 5:Very Often.

In the second network, ties are differentiated in terms of the value placed on the information or advice received ("For each person in the list below, please show how strongly you agree or disagree with the following statement: In general, this person has expertise in areas that are important in the kind of work I do."). The weights in this network is also based on a scale from 0 to 5. 0: I Do Not Know This Person; 1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; and 5: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: the organisational level (1 Research Assistant; 2: Junior Consultant; 3: Senior Consultant; 4: Managing Consultant; 5: Partner), gender (1: male; 2: female), region (1: Europe; 2: USA), and location (1: Boston; 2: London; 3: Paris; 4: Rome; 5: Madrid; 6: Oslo; 7: Copenhagen).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Consulting.node.region

Format

A vector with nodal attribute.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.

<http://toreopsahl.com/datasets/>

Cross.Parker.Manufacturing.net.aware
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a research team in a manufacturing company (77 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties among the researchers are differentiated in terms of advice ("Please indicate the extent to which the people listed below provide you with information you use to accomplish your work"). The weights are based on the following scale: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Very Infrequently; 2: Infrequently; 3: Somewhat Infrequently; 4: Somewhat Frequently; 5: Frequently; and 6: Very Frequently.

The second network is based on the employees' awareness of each others' knowledge and skills ("I understand this person's knowledge and skills. This does not necessarily mean that I have these skills or am knowledgeable in these domains but that I understand what skills this person has and domains they are knowledgeable in"). The weight scale in this network is: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Strongly Disagree; 2: Disagree; 3: Somewhat Disagree; 4: Somewhat Agree; 5: Agree; and 6: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: location (1: Paris; 2: Frankfurt; 3: Warsaw; 4: Geneva), tenure (1: 1-12 months; 2: 13-36 months; 3: 37-60 months; 4: 61+ months) and the organisational level (1: Global Dept Manager; 2: Local Dept Manager; 3: Project Leader; 4: Researcher).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Manufacturing.net.aware

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

Cross.Parker.Manufacturing.net.info

Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a research team in a manufacturing company (77 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties among the researchers are differentiated in terms of advice ("Please indicate the extent to which the people listed below provide you with information you use to accomplish your work"). The weights are based on the following scale: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Very Infrequently; 2: Infrequently; 3: Somewhat Infrequently; 4: Somewhat Frequently; 5: Frequently; and 6: Very Frequently.

The second network is based on the employees' awareness of each others' knowledge and skills ("I understand this person's knowledge and skills. This does not necessarily mean that I have these skills or am knowledgeable in these domains but that I understand what skills this person has and domains they are knowledgeable in"). The weight scale in this network is: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Strongly Disagree; 2: Disagree; 3: Somewhat Disagree; 4: Somewhat Agree; 5: Agree; and 6: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: location (1: Paris; 2: Frankfurt; 3: Warsaw; 4: Geneva), tenure (1: 1-12 months; 2: 13-36 months; 3: 37-60 months; 4: 61+ months) and the organisational level (1: Global Dept Manager; 2: Local Dept Manager; 3: Project Leader; 4: Researcher).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Manufacturing.net.info

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

Cross.Parker.Manufacturing.node.location
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a research team in a manufacturing company (77 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties among the researchers are differentiated in terms of advice ("Please indicate the extent to which the people listed below provide you with information you use to accomplish your work"). The weights are based on the following scale: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Very Infrequently; 2: Infrequently; 3: Somewhat Infrequently; 4: Somewhat Frequently; 5: Frequently; and 6: Very Frequently.

The second network is based on the employees' awareness of each others' knowledge and skills ("I understand this person's knowledge and skills. This does not necessarily mean that I have these skills or am knowledgeable in these domains but that I understand what skills this person has and domains they are knowledgeable in"). The weight scale in this network is: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Strongly Disagree; 2: Disagree; 3: Somewhat Disagree; 4: Somewhat Agree; 5: Agree; and 6: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: location (1: Paris; 2: Frankfurt; 3: Warsaw; 4: Geneva), tenure (1: 1-12 months; 2: 13-36 months; 3: 37-60 months; 4: 61+ months) and the organisational level (1: Global Dept Manager; 2: Local Dept Manager; 3: Project Leader; 4: Researcher).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Manufacturing.node.location

Format

A vector with nodal attribute.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

Cross.Parker.Manufacturing.node.orglevel
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a research team in a manufacturing company (77 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties among the researchers are differentiated in terms of advice ("Please indicate the extent to which the people listed below provide you with information you use to accomplish your work"). The weights are based on the following scale: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Very Infrequently; 2: Infrequently; 3: Somewhat Infrequently; 4: Somewhat Frequently; 5: Frequently; and 6: Very Frequently.

The second network is based on the employees' awareness of each others' knowledge and skills ("I understand this person's knowledge and skills. This does not necessarily mean that I have these skills or am knowledgeable in these domains but that I understand what skills this person has and domains they are knowledgeable in"). The weight scale in this network is: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Strongly Disagree; 2: Disagree; 3: Somewhat Disagree; 4: Somewhat Agree; 5: Agree; and 6: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: location (1: Paris; 2: Frankfurt; 3: Warsaw; 4: Geneva), tenure (1: 1-12 months; 2: 13-36 months; 3: 37-60 months; 4: 61+ months) and the organisational level (1: Global Dept Manager; 2: Local Dept Manager; 3: Project Leader; 4: Researcher).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Manufacturing.node.orglevel

Format

A vector with nodal attribute.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

Cross.Parker.Manufacturing.node.tenure
Intra-organisational networks

Description

This dataset contains two intra-organizational networks from a research team in a manufacturing company (77 employees). These networks was used by Cross and Parker (2004).

In the first network, the ties among the researchers are differentiated in terms of advice ("Please indicate the extent to which the people listed below provide you with information you use to accomplish your work"). The weights are based on the following scale: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Very Infrequently; 2: Infrequently; 3: Somewhat Infrequently; 4: Somewhat Frequently; 5: Frequently; and 6: Very Frequently.

The second network is based on the employees' awareness of each others' knowledge and skills ("I understand this person's knowledge and skills. This does not necessarily mean that I have these skills or am knowledgeable in these domains but that I understand what skills this person has and domains they are knowledgeable in"). The weight scale in this network is: 0: I Do Not Know This Person/I Have Never Met this Person; 1: Strongly Disagree; 2: Disagree; 3: Somewhat Disagree; 4: Somewhat Agree; 5: Agree; and 6: Strongly Agree.

In addition to the relational data, the dataset also contains information about the people (nodal attributes). The following attributes are known: location (1: Paris; 2: Frankfurt; 3: Warsaw; 4: Geneva), tenure (1: 1-12 months; 2: 13-36 months; 3: 37-60 months; 4: 61+ months) and the organisational level (1: Global Dept Manager; 2: Local Dept Manager; 3: Project Leader; 4: Researcher).

See <http://toreopsahl.com/datasets/>

Usage

Cross.Parker.Manufacturing.node.tenure

Format

A vector with nodal attribute.

References

Cross, R., Parker, A., 2004. The Hidden Power of Social Networks. Harvard Business School Press, Boston, MA.
<http://toreopsahl.com/datasets/>

`degree_w`*Degree centrality in a weighted network*

Description

This function calculates two degree measures: the number of contacts that a node is connected to, and the sum of weights on ties originating from a node (out-strength). To calculate the reverse (in-degree, in-strength), specify `type="in"`.

Usage

```
degree_w(net, measure=c("degree", "output"), type="out")
```

Arguments

<code>net</code>	A weighted edgelist
<code>measure</code>	specifies which measures should be calculated
<code>type</code>	shall out- or in-measures be calculated? Default is out. For undirected networks, this setting is irrelevant, but must be specified.

Value

Returns a data.frame with two or three columns: the first contains the node ids of all the nodes in the edgelist, and the second and/or third contain the corresponding degree and/or strength scores.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2008/11/28/network-weighted-network/>

Examples

```
## Load sample data
sample.network.1 <- rbind(
  c(1, 2, 4),
  c(1, 3, 2),
  c(2, 1, 4),
  c(2, 3, 4),
  c(2, 4, 1),
  c(2, 5, 2),
  c(3, 1, 2),
```

```
c(3,2,4),  
c(4,2,1),  
c(5,2,2),  
c(5,6,1),  
c(6,5,1)  
  
## Run the programme  
degree_w(sample.network.1)
```

dichotomise *Dichotomise a weighted network into a binary network*

Description

The dichotomise function creates a binary network from a weighted edgelist.

Usage

```
dichotomise(net,GT=0)
```

Arguments

net	A weighted edgelist
GT	the cut-off parameter. Default is set to 0, so edges/arcs with a weight greater than 0 is set to 1.

Value

Returns the edgelist with edges below the cut-off removed, and all weights equal to 1.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2008/11/28/network-weighted-network/>

Examples

```
## Load sample data
sample <- rbind(
  c(1,2,4),
  c(1,3,2),
  c(2,1,4),
  c(2,3,4),
  c(2,4,1),
  c(2,5,2),
  c(3,1,2),
  c(3,2,4),
  c(4,2,1),
  c(5,2,2),
  c(5,6,1),
  c(6,5,1))

## Run the programme
dichotomise(sample, GT=2)
```

distance_w

Distance in a weighted network

Description

The shortest path length, or geodesic distance, between two nodes in a binary network is the minimum number of steps you need to make to go from one of them to the other. This distance is the quickest connection between nodes when all ties are the same. However, in a weighted network, all ties are not the same. See <http://toreopsahl.com/2009/01/09/average-shortest-distance-in-weighted-networks/> for more details.

Usage

```
distance_w(net, directed=NULL, gonly=TRUE)
```

Arguments

net	A weighted edgelist
directed	logical, whether the network is directed or undirected. Default is NULL, this means that the function checks whether the edgelist is directed or not.
gonly	logical, whether the function should only be calculated for the giant component. Default is TRUE.

Value

Returns a distance matrix.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2009/01/09/average-shortest-distance-in-weighted-networks/>

Examples

```
## Load sample data
sample <- rbind(
  c(1,2,8),
  c(1,4,1),
  c(2,1,8),
  c(2,3,6),
  c(3,2,6),
  c(3,4,10),
  c(4,1,1),
  c(4,3,10))

## Run the programme
distance_w(sample)
```

Freemans.EIES.net.1.n48

Freeman's EIES network 1

Description

Freeman's EIES networks (Freeman, 1979) was the main network used in Wasserman and Faust (1994). This dataset was collected in 1978 and contains three networks of researchers working on social network analysis. The first network contains the personal relationships among 48 of the researchers at the beginning of the study (time 1). The second network is the personal relationship at the end of the study (time 2). In these two networks, all ties have a weight between 0 and 4. 4 represents a close personal friend of the researcher's; 3 represents a friend; 2 represents a person the researcher has met; 1 represents a person the researcher has heard of, but not met; and 0 represents a person unknown to the researcher. The third network is different. It is a matrix with the number of messages sent among 32 of the researchers that used an electronic communication tool (frequency matrix).

There are two pieces of information about each of the 32 researchers that were part of the third network (nodal attributes): the main disciplinary affiliation (1: sociology; 2: anthropology; 3: mathematics or statistics; and 4: others) and the number of citations each researcher had in the

Social Science Citation Index in 1978.

See <http://toreopsahl.com/datasets/>

Usage

Freemans.EIES.net.1.n48

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Freeman, S.C., Freeman, L.C., 1979. The networkers network: A study of the impact of a new communications medium on sociometric structure. Social Science Research Reports 46. University of California, Irvine, CA.

See <http://toreopsahl.com/datasets/>

Freemans.EIES.net.2.n48

Freeman's EIES network 2

Description

Freeman's EIES networks (Freeman, 1979) was the main network used in Wasserman and Faust (1994). This dataset was collected in 1978 and contains three networks of researchers working on social network analysis. The first network contains the personal relationships among 48 of the researchers at the beginning of the study (time 1). The second network is the personal relationship at the end of the study (time 2). In these two networks, all ties have a weight between 0 and 4. 4 represents a close personal friend of the researcher's; 3 represents a friend; 2 represents a person the researcher has met; 1 represents a person the researcher has heard of, but not met; and 0 represents a person unknown to the researcher. The third network is different. It is a matrix with the number of messages sent among 32 of the researchers that used an electronic communication tool (frequency matrix).

There are two pieces of information about each of the 32 researchers that were part of the third network (nodal attributes): the main disciplinary affiliation (1: sociology; 2: anthropology; 3: mathematics or statistics; and 4: others) and the number of citations each researcher had in the Social Science Citation Index in 1978.

See <http://toreopsahl.com/datasets/>

Usage

Freemans.EIES.net.2.n48

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Freeman, S.C., Freeman, L.C., 1979. The networkers network: A study of the impact of a new communications medium on sociometric structure. Social Science Research Reports 46. University of California, Irvine, CA.

See <http://toreopsahl.com/datasets/>

Freemans.EIES.net.3.n32

Freeman's EIES network 3

Description

Freeman's EIES networks (Freeman, 1979) was the main network used in Wasserman and Faust (1994). This dataset was collected in 1978 and contains three networks of researchers working on social network analysis. The first network contains the personal relationships among 48 of the researchers at the beginning of the study (time 1). The second network is the personal relationship at the end of the study (time 2). In these two networks, all ties have a weight between 0 and 4. 4 represents a close personal friend of the researcher's; 3 represents a friend; 2 represents a person the researcher has met; 1 represents a person the researcher has heard of, but not met; and 0 represents a person unknown to the researcher. The third network is different. It is a matrix with the number of messages sent among 32 of the researchers that used an electronic communication tool (frequency matrix).

There are two pieces of information about each of the 32 researchers that were part of the third network (nodal attributes): the main disciplinary affiliation (1: sociology; 2: anthropology; 3: mathematics or statistics; and 4: others) and the number of citations each researcher had in the Social Science Citation Index in 1978.

See <http://toreopsahl.com/datasets/>

Usage

Freemans.EIES.net.3.n32

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Freeman, S.C., Freeman, L.C., 1979. The networkers network: A study of the impact of a new communications medium on sociometric structure. Social Science Research Reports 46. University of California, Irvine, CA.

See <http://toreopsahl.com/datasets/>

Freemans.EIES.node.Citations.n32

Freeman's EIES network: citations (nodal attribute)

Description

Freeman's EIES networks (Freeman, 1979) was the main network used in Wasserman and Faust (1994). This dataset was collected in 1978 and contains three networks of researchers working on social network analysis. The first network contains the personal relationships among 48 of the researchers at the beginning of the study (time 1). The second network is the personal relationship at the end of the study (time 2). In these two networks, all ties have a weight between 0 and 4. 4 represents a close personal friend of the researcher's; 3 represents a friend; 2 represents a person the researcher has met; 1 represents a person the researcher has heard of, but not met; and 0 represents a person unknown to the researcher. The third network is different. It is a matrix with the number of messages sent among 32 of the researchers that used an electronic communication tool (frequency matrix).

There are two pieces of information about each of the 32 researchers that were part of the third network (nodal attributes): the main disciplinary affiliation (1: sociology; 2: anthropology; 3: mathematics or statistics; and 4: others) and the number of citations each researcher had in the Social Science Citation Index in 1978.

See <http://toreopsahl.com/datasets/>

Usage

Freemans.EIES.node.Citations.n32

Format

A vector with the number of citations.

References

Freeman, S.C., Freeman, L.C., 1979. The networkers network: A study of the impact of a new communications medium on sociometric structure. Social Science Research Reports 46. University of California, Irvine, CA.

See <http://toreopsahl.com/datasets/>

```
Freemans.EIES.node.Discipline.n32
```

Freeman's EIES network: discipline (nodal attribute)

Description

Freeman's EIES networks (Freeman, 1979) was the main network used in Wasserman and Faust (1994). This dataset was collected in 1978 and contains three networks of researchers working on social network analysis. The first network contains the personal relationships among 48 of the researchers at the beginning of the study (time 1). The second network is the personal relationship at the end of the study (time 2). In these two networks, all ties have a weight between 0 and 4. 4 represents a close personal friend of the researcher's; 3 represents a friend; 2 represents a person the researcher has met; 1 represents a person the researcher has heard of, but not met; and 0 represents a person unknown to the researcher. The third network is different. It is a matrix with the number of messages sent among 32 of the researchers that used an electronic communication tool (frequency matrix).

There are two pieces of information about each of the 32 researchers that were part of the third network (nodal attributes): the main disciplinary affiliation (1: sociology; 2: anthropology; 3: mathematics or statistics; and 4: others) and the number of citations each researcher had in the Social Science Citation Index in 1978.

See <http://toreopsahl.com/datasets/>

Usage

```
Freemans.EIES.node.Discipline.n32
```

Format

A vector with the discipline of researchers.

References

Freeman, S.C., Freeman, L.C., 1979. The networkers network: A study of the impact of a new communications medium on sociometric structure. Social Science Research Reports 46. University of California, Irvine, CA.

See <http://toreopsahl.com/datasets/>

```
Newman.Condmat.95.99.net.1mode.wNewman
```

Newman's condmat 95-99 network (one-mode structure)

Description

This is the co-authorship network of scientists based on preprints posted to Condensed Matter section of arXiv E-Print Archive between 1995 and 1999.

This network can be classified as a two-mode or affiliation network since there are two types of "nodes" (authors and papers) and connections exist only between different types of nodes. An author is connected to a paper if her or his name appeared on it.

Few network measures exist for two-mode networks, and therefore, these networks are often projected onto a one-mode (only one type of nodes) network by selecting one of the types of nodes and linking two nodes if they were connected to the same node (of the other kind).

Traditionally, the ties in projected one-mode networks do not have weights. Recent empirical studies of two-mode networks has created a weighted network by defining the weights as the number of co-occurrences (e.g., the number of papers that two authors had collaborated on).

This method was refined by Newman (2001). He argued that smaller collaborations created stronger social bonds among scientists than larger ones. Therefore, he extended this procedure and proposed to define weights among the nodes use the following formula:

$$w_{ij} = \frac{p}{N_p - 1}$$

where w_{ij} is the weight between node i and node j , p is the papers that they have collaborated on, and N_p is the number of authors on a paper. This implies that if two authors only write a single paper together with no other co-authors, they get a weight of 1. However, if they have a co-author, the weight on the tie between them is 0.5. If two authors have written two papers together without any co-author, the weight of their tie would be 2. A more complicated example is the tie between two authors who have written two papers together: one without any other co-author and one with one co-author. The first paper would give their tie a weight of 1, and the second tie would add 0.5 to the weight of this tie. Therefore, the weight is 1.5.

Note: This method has been explained in more detail in the following post:

<http://toreopsahl.com/2009/05/01/projecting-two-mode-networks-onto-weighted-one-mode-networks/>

This is the one-mode network where the weights are defined by Newman's (2001) method. See <http://toreopsahl.com/datasets/>

Usage

Newman.Cndmat.95.99.net.1mode.wNewman

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Newman, M. E. J., 2001. The structure of scientific collaboration networks. Proceedings of the National Academy of Sciences of the United States of America 98, 404-409.
See <http://toreopsahl.com/datasets/>

 Newman.Condmat.95.99.net.2mode

Newman's condmat 95-99 network (two-mode structure)

Description

This is the co-authorship network of scientists based on preprints posted to Condensed Matter section of arXiv E-Print Archive between 1995 and 1999.

This network can be classified as a two-mode or affiliation network since there are two types of "nodes" (authors and papers) and connections exist only between different types of nodes. An author is connected to a paper if her or his name appeared on it.

Few network measures exist for two-mode networks, and therefore, these networks are often projected onto a one-mode (only one type of nodes) network by selecting one of the types of nodes and linking two nodes if they were connected to the same node (of the other kind).

Traditionally, the ties in projected one-mode networks do not have weights. Recent empirical studies of two-mode networks has created a weighted network by defining the weights as the number of co-occurrences (e.g., the number of papers that two authors had collaborated on).

This method was refined by Newman (2001). He argued that smaller collaborations created stronger social bonds among scientists than larger ones. Therefore, he extended this procedure and proposed to define weights among the nodes use the following formula:

$$w_{ij} = \sum_p 1/(N_p - 1)$$

where w_{ij} is the weight between node i and node j , p is the papers that they have collaborated on, and N_p is the number of authors on a paper. This implies that if two authors only write a single paper together with no other co-authors, they get a weight of 1. However, if they have a co-author, the weight on the tie between them is 0.5. If two authors have written two papers together without any co-author, the weight of their tie would be 2. A more complicated example is the tie between two authors who have written two papers together: one without any other co-author and one with one co-author. The first paper would give their tie a weight of 1, and the second tie would add 0.5 to the weight of this tie. Therefore, the weight is 1.5.

Note: This method has been explained in more detail in the following post:

<http://toreopsahl.com/2009/05/01/projecting-two-mode-networks-onto-weighted-one-mode-networks/>

This is the two-mode network. See <http://toreopsahl.com/datasets/>

Usage

Newman.Condmat.95.99.net.2mode

Format

A data frame with two columns. The first is the id of authors and the second is the id of papers.

References

Newman, M. E. J., 2001. The structure of scientific collaboration networks. Proceedings of the National Academy of Sciences of the United States of America 98, 404-409.
See <http://toreopsahl.com/datasets/>

OnlineComm.f1000.lnet

Online community - extract

Description

The first 1000 rows of a longitudinal edgelist constructed from an online community.

Usage

OnlineComm.f1000.let

Format

A data frame with four columns. The first is the time stamp at which the message was send; the second is the id of the sender; the third is the id of the receiver; and the fourth is the weight (always 1 as this network does not contain any information about the severing of ties).

References

Opsahl, T., Panzarasa, P., 2009. Clustering in weighted networks. Social Networks 31 (2), 155-163, doi: 10.1016/j.socnet.2009.02.002
<http://toreopsahl.com/2009/04/03/article-clustering-in-weighted-networks/>

projecting_tm

Projecting binary and weighted two-mode networks onto weighted one-mode networks.

Description

This function is the implementation of the procedure outlined on <http://toreopsahl.com/2009/05/01/projecting-two-mode-networks-onto-weighted-one-mode-networks/>

Usage

```
projecting_tm(net, method = "sum")
```

Arguments

net A two-mode edgelist

method The method-switch control the method used to calculate the weights.
 binary sets all weights to 1
 sum sets the weights to the number of cooccurances
 Newman bases the weights on Newman's (2001) method of discounting for the size of collaborations.

Value

Returns a one-mode network

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Opsahl, T., 2009. Projecting two-mode networks onto weighted one-mode networks. Available at: <http://toreopsahl.com/2009/05/01/projecting-two-mode-networks-onto-weighted-one-mode-networks/>

Examples

```
## define two-mode network
two.mode.net <- cbind(
  i=c(1,1,2,2,2,2,2,3,4,5,5,5,6),
  p=c(1,2,1,2,3,4,5,2,3,4,5,6,6))

## Run clustering function
projecting_tm(two.mode.net, method="Newman")
```

random_values

Finds the randomly expected values by simulations

Description

Finds the randomly expected values by simulations

Usage

```
random_values(net, NR=1000, step=c(1,2,3))
```

Arguments

net	A weighted edgelist
NR	Number of random networks
step	Which steps to perform: 1) calculating values on observed network, 2) calculating values on weight reshuffled networks, and 3) calculating values on link reshuffled networks.

Value

Summary information is written to the screen, and detailed information is returned as follows:

[[1]][[1]]

This is variable 1, which is the weighted clustering coefficient: clustering_w(net, measure=c("am", "gm", "ma", "mi", "bi"))

[[2]]

This is variable 2, which is binary distance matrix: distance_w(net.b)

[[3]]

This is variable 3, which is weighted distance matrix: distance_w(net)

[[4]]

This is variable 4, which is matrix with the results from the weight reshuffled random networks (rows) and different measures (columns), which are

1 to 5: clustering_w(net.r, measure=c("am", "gm", "ma", "mi", "bi"))

6: average binary distance

7: average weighted distance

8: normalised weighted distance

9: size of giant component

[[5]]

This is variable 5, which is matrix with the results from the link reshuffled random networks (rows) and different measures (columns), which are

1 to 5: clustering_w(net.r, measure=c("am", "gm", "ma", "mi", "bi"))

6: average binary distance

7: average weighted distance

8: normalised weighted distance

9: size of giant component

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

Examples

```
## Load sample data
sample <- rbind(
  c(1, 2, 4),
  c(1, 3, 2),
```

```
c(2,1,4),
c(2,3,4),
c(2,4,1),
c(2,5,2),
c(3,1,2),
c(3,2,4),
c(4,2,1),
c(5,2,2),
c(5,6,1),
c(6,5,1)

## Run the programme
random_values(sample, NR=2)
```

rg_reshuffling_tm *Reshuffle of a binary two-mode network*

Description

This function randomly resuffles a binary two-mode edgelist.

Usage

```
rg_reshuffling_tm(net, seed=NULL)
```

Arguments

net	A two-mode edgelist
seed	seed for random generator, set if you want random yet reproducible results.

Value

Returns a binary two-mode edgelist.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2009/05/29/weighted-rich-club-effect-a-more-appropriate-null-model-for-scientific-collaboration-networks/>

Examples

```
## Load data (subset)
net <- read.table("http://opsahl.co.uk/tnet/datasets/Newman-Cond_mat_95-99-two_mode.txt", nr)

## Run the function
rg_reshuffling_tm(net, seed=1)
```

rg_reshuffling_w *Reshuffle of a weighted network*

Description

This function randomly resuffles a weighted edgelist.

Usage

```
rg_reshuffling_w(net, option="weights", directed=NULL, seed=NULL)
```

Arguments

net	A weighted edgelist
option	what should be reshuffled: 1) weights (default): randomly assigns the weights to the edges; 2) links: maintain the degree distribution, but changes the contacts randomly.
directed	logical: is the network directed or undirected. Default: NULL
seed	seed for random generator, set if you want random yet reproducible results.

Value

Returns a randomised (reshuffled) network.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Molloy, M., Reed, B., 1995. A critical point for random graphs with a given degree sequence. *Random Structures and Algorithms* 6, 161-180.

Opsahl, T., Colizza, V., Panzarasa, P., Ramasco, J. J., 2008. Prominence and control: The weighted rich-club effect. *Physical Review Letters* 101 (168702). arXiv:0804.0417.

<http://toreopsahl.com/2008/12/12/article-prominence-and-control-the-weighted-rich-club-effect/>

Examples

```
## Load sample data
sampledata<-rbind(
  c(1,2,4),
  c(1,3,2),
  c(2,1,4),
  c(2,3,4),
  c(2,4,1),
  c(2,5,2),
  c(3,1,2),
  c(3,2,4),
  c(4,2,1),
  c(5,2,2),
  c(5,6,1),
  c(6,5,1));

## Run the function
rg_resuffling_w(sampledata, option="weights", directed=FALSE)
```

rg_tm

Random binary and weighted two-mode network

Description

Creates random binary and weighted two-mode networks

Usage

```
rg_tm(ni=100, np=100, ties=300, max.weight=1, seed=NULL)
```

Arguments

ni	Number of nodes in the first set
np	Number of nodes in the second set
ties	Number of ties
max.weight	Max weight (see rg_w), if set to 1 a binary network is produced.
seed	the random seed. If you want it to be non-reproducible, use NULL otherwise, use a number

Value

Returns a random two-mode network

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Opsahl, T., 2009. Clustering in Two-mode Networks.

Examples

```
## Run the programme
rg_tm(ni=10,np=10,ties=20,max.weight=1,seed=NULL)
```

rg_w

Random weighted network generator

Description

This function creates a random network with random edge weights.

Usage

```
rg_w(nodes=100,arcs=300,max.weight=10,directed=TRUE,seed=NULL)
```

Arguments

nodes	number of nodes
arcs	number of arcs
max.weight	maximum weight, weights are allocated values randomly between 1 and this number
directed	whether you want a directed or undirected network, values TRUE or FALSE
seed	the random seed. If you want it to be non-reproducible, use NULL otherwise, use a number

Value

Returns a random edgelist with random weights.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://opsahl.co.uk/tnet/>

Examples

```
rg_w(nodes=10,arcs=30,max.weight=5,directed=FALSE,seed=1)
```

```
shrink_to_weighted_network
```

Shrink a repetitive edgelist into a weighted

Description

This function creates a weighted edgelist from a list of edges where a duplicate means an increase in the weight.

Usage

```
shrink_to_weighted_network(net)
```

Arguments

net	can use both undirected and directed edgelist in the following format (sender.id receiver.id weight):
	1 2
	1 2
	1 2
	1 2
	1 3
	1 3

Value

Returns a weighted edgelist

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2008/11/28/network-weighted-network/>

Examples

```
## Load sample data
sample <- rbind(
  c(1,2),
  c(1,2),
  c(1,2),
  c(1,2),
  c(1,3),
  c(1,3),
  c(2,1),
  c(2,1),
  c(2,1),
  c(2,1),
  c(2,3),
  c(2,3),
  c(2,3),
  c(2,3),
  c(2,4),
  c(2,5),
  c(2,5),
  c(3,1),
  c(3,1),
  c(3,2),
  c(3,2),
  c(3,2),
  c(3,2),
  c(4,2),
  c(5,2),
  c(5,2),
  c(5,6),
  c(6,5))

## Run the programme
shrink_to_weighted_network(sample)
```

symmetrise

Symmetrise

Description

The `symmetrise` function creates an undirected edgelist from a directed edgelist.

Usage

```
symmetrise(net, method="MAX")
```

Arguments

net	A directed weighted edgelist
method	the method used to decide the weight of the undirected edge. It can be: "MAX" sets the weight to the maximum of the weight(s) of the arc(s) "MIN" sets the weight to the minimum of the weight(s) of the arc(s) "AMEAN" sets the weight to the average (arithmetic mean) of the weight(s) of the arc(s) "SUM" sets the weight to the sum of the weight(s) of the arc(s) "PROD" sets the weight to the product of the weight(s) of the arc(s) "DIFF" sets the weight to the absolute difference between the weight(s) of the arc(s)

Value

Returns the undirected edgelist.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

<http://toreopsahl.com/2008/11/28/network-weighted-network/>

Examples

```
## Load sample data
sample <- rbind(
  c(1, 2, 2),
  c(1, 3, 2),
  c(2, 1, 4),
  c(2, 3, 4),
  c(2, 4, 1),
  c(2, 5, 2),
  c(3, 1, 2),
  c(3, 2, 4),
  c(5, 2, 2),
  c(5, 6, 1))

## Run the programme
symmetrise(sample, method="MAX")
```

USairport.n500.net *The network among the 500 busiest US commercial airports.*

Description

The nodes in this network is the 500 busiest commercial airports in the United States. A tie exists between two airports if a flight was scheduled between them in 2002. The weights corresponds to the number of seats available on the scheduled flights. Even though this type of networks is directed by nature as a flight is scheduled from one airport and to another, the networks are highly symmetric (Barrat et al., 2004). Therefore, the version of this network is undirected (i.e., the weight of the tie from one airport towards another is equal to the weight of the reciprocal tie). This network was obtained from the Complex Networks Collaboratory's website

See <http://toreopsahl.com/datasets/>

Usage

USairport.n500.net

Format

A data frame with three columns. The first is the id of the sender; the second is the id of the receiver; and the third is the weight of the tie.

References

Colizza, V., Pastor-Satorras, R., Vespignani, A., 2007. Reaction-diffusion processes and metapopulation models in heterogeneous networks. *Nature Physics* 3, 276-282.

See <http://toreopsahl.com/datasets/>

weighted_richclub_tm

The weighted rich-club effect (two-mode networks)

Description

This function calculates the weighted rich-club coefficient proposed in Opsahl, T., Colizza, V., Panzarasa, P., Ramasco, J.J., 2008. Prominence and control: The weighted rich-club effect. *PRL* 101. It incorporates two extensions:

1) a new way of reshuffling (two-mode reshuffling;

<http://toreopsahl.com/2009/05/29/weighted-rich-club-effect-a-more-appropriate-null-model-for-scientific-collaboration-networks/>)

2) calculating significance levels if there are more than 100 random networks (see my PhD thesis; <http://toreopsahl.com/publications/thesis/>)

Usage

```
weighted_richclub_tm(net, NR=1000, seed=NULL, projection.method="Newman", nbins=30)
```

Arguments

<code>net</code>	A binary two-mode edgelist
<code>NR</code>	number of random networks used.
<code>seed</code>	the random generators seed, used to produce random yet reproducible results.
<code>projection.method</code>	the method used to project the two-mode network to a weighted one-mode network: either "sum" or "Newman"
<code>nbins</code>	the number of bins in the output

Value

Returns a table with the fraction of $\phi(\text{observed})$ over $\phi(\text{null})$. Nbins controls the number of rows.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Opsahl et al., 2008. Prominence and control: The weighted rich-club effect. PRL 101
<http://toreopsahl.com/2008/12/12/article-prominence-and-control-the-weighted-rich-club-effect/>
<http://toreopsahl.com/2009/05/29/weighted-rich-club-effect-a-more-appropriate-null-model-for-scientific-collaboration-networks/>

Examples

```
## Load data (subset)
net <- read.table("http://opsahl.co.uk/tnet/datasets/Newman-Cond_mat_95-99-two_mode.txt", nr)

## Run the function
weighted_richclub_tm(net, NR=10)
```

`weighted_richclub_w`*The weighted rich-club effect*

Description

This function calculates the weighted rich-club coefficient proposed in Opsahl, T., Colizza, V., Panzarasa, P., Ramasco, J.J., 2008. Prominence and control: The weighted rich-club effect. PRL 101. <http://toreopsahl.com/2008/12/12/article-prominence-and-control-the-weighted-rich-club-effect/> Note that when specifying rich="s", you should also specify reshuffle="weights.local" as this method maintains the out-strength of nodes.

Usage

```
weighted_richclub_w(net, rich="k", reshuffle="weights", samples=100, seed=NULL, directed)
```

Arguments

<code>net</code>	A weighted edgelist
<code>rich</code>	specifies the richness parameter, either "k" or "s".
<code>reshuffle</code>	specifies the reshuffling procedure used, either "weights" or "links".
<code>samples</code>	number of random networks used.
<code>seed</code>	the random generators seed, used to produce random yet reproducible results.
<code>directed</code>	logical parameter: whether the network is directed or undirected.

Value

Returns a table with the fraction of $\phi(\text{observed})$ over $\phi(\text{null})$ for each k or s in the dataset.

Note

version 1.0.0

Author(s)

Tore Opsahl; <http://toreopsahl.com>

References

Opsahl et al., 2008. Prominence and control: The weighted rich-club effect. PRL 101 <http://toreopsahl.com/2008/12/12/article-prominence-and-control-the-weighted-rich-club-effect/>

Examples

```
## Load sample data
sampledata <- rbind(
  c(1,2,4),
  c(1,3,2),
  c(2,1,4),
  c(2,3,4),
  c(2,4,1),
  c(2,5,2),
  c(3,1,2),
  c(3,2,4),
  c(4,2,1),
  c(5,2,2),
  c(5,6,1),
  c(6,5,1))

## Run the function
weighted_richclub_w(sampledata, rich="k", reshuffle="weights")
```


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