Package 'DirectedClustering'

October 12, 2022

Type Package

Title Directed Weighted Clustering Coefficient

Version 0.1.1

Date 2018-01-10

Author Gian Paolo Clemente[cre,aut], Rosanna Grassi [ctb]

Maintainer Gian Paolo Clemente <gianpaolo.clemente@unicatt.it>

Description Allows the computation of clustering coefficients for directed and weighted networks by using different approaches.
It allows to compute clustering coefficients that are not present in 'igraph' package.
A description of clustering coefficients can be found in ``Directed clustering in weighted networks: a new perspective'', Clemente, G.P., Grassi, R. (2017),
<doi:10.1016/j.chaos.2017.12.007>.

License GPL-3 | file LICENSE

Depends R(>= 3.4.0)

Imports igraph

RoxygenNote 6.0.1

NeedsCompilation no

Repository CRAN

Date/Publication 2018-01-11 12:12:59 UTC

R topics documented:

1

DirectedClustering-package

Alternative Clustering Coefficients for Directed/Undirected and Weighted Networks

---

Description

The **DirectedClustering** R package presented here includes an enhanced R implementation of Local and Global (average) Clustering Coefficients for Directed/Undirected and Unweighted/Weighted Networks.

Functions are based on Barrat et al. (2004) and Onnela et al. (2005) coefficients when the network is undirected, while it is based on Fagiolo (2007) and Clemente and Grassi (2018) proposals when the network is directed. In the directed case, different components of directed clustering coefficient are also considered.

Details of alternative coefficients computed by **DirectedClustering** R package can be found in Clemente, Grassi (2018).

Please report any issue arising or bug in the code to gianpaolo.clemente@unicatt.it.

Note

This package and the functions herein are provided as is, without any guarantee regarding the accuracy of calculations. The authors disclaim any liability arising by any losses due to direct and indirect use of this package.

Author(s)

Gian Paolo Clemente, gianpaolo.clemente@unicatt.it, Rosanna Grassi, rosanna.grassi@unimib.it

References

Clemente, G.P. and Grassi, R. (2018) Directed clustering in weighted networks: a new perspective, *Chaos, Solitons and Fractals*, **107**,26–38.

ClustBCG

Clustering Coefficient for Directed/Undirected and Weighted Networks (Barrat et al. (2004) and Clemente, Grassi (2018) coefficients).

Description

Compute Local and Global (average) Clustering Coefficients for Directed/Undirected and Unweighted/Weighted Networks.

Formulas are based on Barrat et al. (2004) coefficient when the network is undirected, while it is based on Clemente and Grassi (2018) proposal when the network is directed.

In the directed case, different components of directed clustering coefficient are also provided.

Usage

```
ClustBCG(mat, type = "undirected", isolates = "zero")
```

Arguments

mat	A Weighted Adjacency Matrix
type	The type of the clustering coefficient to calculate. Possible values are: "undirected" (default) or "undirected".
isolates	Character scalar, defines how to treat vertices with degree zero and one. If it is 'NaN' then their local transitivity is reported as NaN and they are not included in the averaging. If it is 'zero', then we report 0 transitivity for them, and they are included in the averaging. Default value is 'zero'.

Details

The function `ClustBCG` computes Barrat et al. coefficient when a weighted and undirected network is considered.
For directed network Clemente and Grassi formula is computed.
In case of unweighted and undirected graphs, it provides classical local clustering coefficient (Watts and Strogatz).

In all cases, local clustering coefficients are obtained for each node, the global coefficient is the average of local coefficients.
These clustering coefficients do not work for graphs with multiple and/or loop edges. Hence, loops are removed.
In the directed case, different components of directed clustering coefficient are also considered.

Value

For 'undirected case':

LocalCC	Local clustering coefficients
GlobalCC	Global clustering coefficient

For 'directed case':

cycleCC	Local Cycle clustering coefficients
middlemanCC	Local Middleman clustering coefficients
inCC	Local In clustering coefficients
outCC	Local Out clustering coefficients
totalCC	Local Total clustering coefficients
GlobalcycleCC	Global Cycle clustering coefficient
GlobalmiddlemanCC	
	Global Middleman clustering coefficient
GlobalinCC	Global In clustering coefficient
GlobaloutCC	Global Out clustering coefficient
GlobaltotalCC	Global Total clustering coefficient

Author(s)

Gian Paolo Clemente, gianpaolo.clemente@unicatt.it

References

Barrat, A. and Barthelemy, M. and Pastor-Satorras, R. and Vespignani, A. (2004) The architecture of complex weighted networks, *Proc. Natl. Acad. Sci.*, USA **101**, 3747.

Clemente, G.P. and Grassi, R. (2018) Directed clustering in weighted networks: a new perspective, *Chaos, Solitons and Fractals*, **107**,26–38.

Watts, D.J. and Strogatz, S.H. (1998) Collective dynamics of 'small-world 'networks. *Nature*, **393**, 440-442.

Examples

```
library(igraph)
#Generate a Weighted and Undirected graph with Erdos Renyi Model
gsim<-erdos.renyi.game(50, 0.5, type="gnp", directed = FALSE, loops = FALSE)
PESI<-runif(length(E(gsim)), 0, 1)
E(gsim)$weight<-PESI

#Get Adjacency
A<-get.adjacency(gsim, sparse=FALSE, attr="weight")
#Compute Barrat et al. (2004) coefficient
BarratClust<-ClustBCG(A, "undirected")

#The same results can be obtained with igraph::transitivity
check<-sum(BarratClust$LocalCC-transitivity(gsim, "weighted"))

#Generate a Weighted and Directed Graph with Erdos Renyi Model
gsim<-erdos.renyi.game(50, 0.5, type="gnp", directed = TRUE, loops = FALSE)
PESI<-runif(length(E(gsim)), 0, 1)
E(gsim)$weight<-PESI

#Get Adjacency
A<-get.adjacency(gsim, sparse=FALSE, attr="weight")

#Compute Clemente, Grassi (2018) coefficient
CGClust<-ClustBCG(A, "directed")
```

ClustF	*Clustering Coefficients for Directed/Undirected and Weighted Networks (Onnela et al. (2005) and Fagiolo (2007) coefficients)*

Description

This function computes both Local and Global (average) Clustering Coefficients for either Directed/Undirected and Unweighted/Weighted Networks.
Formulas are based on Onnela et al. (2005) coefficient when the network is undirected, while it is

based on Fagiolo (2007) coefficient when the network is directed.
In the directed case, different components of directed clustering coefficient are also considered.

Usage

```
ClustF(mat, type = "undirected", isolates = "zero", norm=1)
```

Arguments

mat	A Weighted Adjacency Matrix. If weights are greater than one, a normalization is provided by dividing each weight by the maximum weight observed.
type	The type of the clustering coefficient to calculate. Possible values are: "undirected" (default) or "undirected".
isolates	Character scalar, defines how to treat vertices with degree zero and one. If it is 'NaN' then their local transitivity is reported as NaN and they are not included in the averaging. If it is 'zero', then we report 0 transitivity for them, and they are included in the averaging. Default value is 'zero'.
norm	If it is 1 (default), link's weights are normalized by dividing by the maximum observed weight (as proposed in Fagiolo). Otherwise, weights are not normalized. It is worth pointing out that weights are always normalized when the maximum weight is greater than zero. This normalization assures that clustering coefficient ranges between 0 and 1.

Details

The function `ClustF` computes Onnela et al. formula when weighted and undirected networks are considered.
For directed networks, Fagiolo formula is computed. In case of unweighted and undirected graphs, it provides classical local clustering coefficient (Watts and Strogatz).

Local coefficients are obtained for each node, the global coefficient is the average of local coefficients.
These clustering coefficients do not work for graphs with multiple and/or loop edges. Hence, loops are removed.
In the directed case, different components of directed clustering coefficient are also provided.

Value

For 'undirected case':

LocalCC	Local clustering coefficients
GlobalCC	Global clustering coefficient

For 'directed case':

cycleCC	Local Cycle clustering coefficients
middlemanCC	Local Middleman clustering coefficients
inCC	Local In clustering coefficients
outCC	Local Out clustering coefficients

totalCC	Local Total clustering coefficients
GlobalcycleCC	Global Cycle clustering coefficient
GlobalmiddlemanCC	
	Global Middleman clustering coefficient
GlobalinCC	Global In clustering coefficient
GlobaloutCC	Global Out clustering coefficient
GlobaltotalCC	Global Total clustering coefficient

Author(s)

Gian Paolo Clemente, gianpaolo.clemente@unicatt.it

References

Fagiolo, G. (2007) Clustering in complex directed networks. *Physical Review E*, **76(2)**.

Onnela, J.P. and Saramaki, J. and Kertsz, J. and Kaski, K. (2005) Intensity and coherence of motifs in weighted complex networks. *Physical Review E*, **71(6)**.

Watts, D. J. and Strogatz, S. H. (1998), Collective dynamics of 'small-world' networks *Nature*, **393**, 440-442.

Examples

```
library(igraph)
#Generate a Weighted and Undirected graph with Erdos Renyi Model
gsim<-erdos.renyi.game(50, 0.5, type="gnp", directed = FALSE, loops = FALSE)
PESI<-runif(length(E(gsim)), 0, 1)
E(gsim)$weight<-PESI

#Get Adjacency
A<-get.adjacency(gsim, sparse=FALSE, attr="weight")

#Compute Onnela et al. (2005) coefficient
OnnelaClust<-ClustF(A, "undirected")

#Generate a Weighted and Directed Graph with Erdos Renyi Model
gsim<-erdos.renyi.game(50, 0.5, type="gnp", directed = TRUE, loops = FALSE)
PESI<-runif(length(E(gsim)), 0, 1)
E(gsim)$weight<-PESI

#Get Adjacency
A<-get.adjacency(gsim, sparse=FALSE, attr="weight")

#Compute Fagiolo (2007) coefficient
FagioloClust<-ClustF(A, "directed")
```

Index