

# Package ‘CIDnetworks’

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**Type** Package

**Title** Generative Models for Complex Networks with Conditionally Independent Dyadic Structure

**Version** 0.8.1

**Date** 2015-03-10

**Description** Generative models for complex networks with conditionally independent dyadic structure. Now supports directed arcs!

**License** GPL (> 3)

**Depends** R (>= 3.0.0)

**Imports** mvtnorm, msm, methods, Rcpp (>= 0.11.0), igraph, numDeriv, pbivnorm, MASS

**LinkingTo** Rcpp

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CIDnetworks-package    *Model Complex Networks With Multiple Components*

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### Description

The CIDnetworks package allows a user to construct hierarchical models of complex networks using one of many different modes for latent structure.

### Details

Package: CIDnetworks  
Type: Package  
Version: 0.8.0  
Date: 2014-03-10  
License: GPLv3

### Author(s)

Beau Dabbs, Brian Junker, Mauricio Sadinle, Tracy Sweet, A.C. Thomas Maintainer: Beau Dabbs  
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### Examples

```
data(dolphins)
model.plain <- CID.Gibbs (input=dolphins, burnin=10, draws=10)
```

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CIDnetworks-classes    *Classes of CIDnetwork subcomponents*

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### Description

Each of the reference classes used as components in the CIDnetworks methodology.

### Usage

```
BETA(...)  
EdgeCOV (... , cov.type="Edge")  
SenderCOV (...)  
ReceiverCOV (...)
```

SendRecCOV (...)  
 IdenticalCOV (...)  
 HBM (...)  
 LSM (...)  
 LVM (...)  
 MMSBM (...)  
 SBM (...)  
 SR (...)

### Arguments

... Arguments passed to the respective classes.  
 cov.type Specifies the type of covariate effect. Edge specifies Edge-level covariate effects.

### Details

Each of these functions can serve as a subcomponent in the main CIDnetwork class object. Information on the nodes, edge list, and so forth will be passed automatically by any routine creating a CID object. Options are generally provided by default. Arguments for each class:

BETA: required: (nothing). Parameters: intercept.sr.

EdgeCOV: required: covariates (matrix). Parameters: Corresponding coefficient vector coef.cov.

SenderCOV: required: covariates (vector of length n.nodes). Parameters: Corresponding coefficient vector coef.cov.

ReceiverCOV: required: covariates (vector of length n.nodes). Parameters: Corresponding coefficient vector coef.cov.

SendRecCOV: required: covariates (vector of length n.nodes). Parameters: Corresponding coefficient vector coef.cov.

IdenticalCOV: required: covariates (vector of length n.nodes). Parameters: Corresponding coefficient vector coef.cov.

HBM: required: n.groups (single value). Parameters: block.value, membership (for nodes to blocks), tree.parent (for blocks).

LSM: required: dimension (single value). Parameters: latent.space.pos.

LVM: required: dimension (single value). Parameters: latent.space.pos.

MMSBM: required: n.groups (single value). Parameters: b.vector, membership.edge, membership.node.

SBM: required: n.groups (single value). Parameters: b.vector, membership.

SR: required: (nothing). Parameters: intercept.sr.

### Value

Each expression yields a Reference Class object for the respective submodel. If generate=TRUE, it will produce an outcome value for that class depending on its specific properties.

**Author(s)**

A.C. Thomas <act@acthomas.ca>

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CIDnetworks-data

*CIDnetworks: Included Data Sets*

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**Description**

Data sets included with the CIDnetworks package.

**Usage**

Lazega  
c.elegans  
dolphins  
prison  
Advice

**Format**

Lazega: A list including six sociomatrices (three directed, three symmetrized) and one attributes matrix for the nodes.

c.elegans: An symmetric valued "sociomatrix" for the number of connections between neurons.

dolphins: A symmetric sociomatrix.

prison: (Thanks to UCINET) In the 1950s John Gagnon collected sociometric choice data from 67 prison inmates. All were asked, "What fellows on the tier are you closest friends with?" Each was free to choose as few or as many "friends" as he desired.

Advice: A set of teacher advice networks from 15 different schools. Also includes edge.covariates which are covariates for each edge and SR.covariates, which are covariates for each node.

**Author(s)**

A.C. Thomas <act@acthomas.ca>

**References**

Emmanuel Lazega. The Collegial Phenomenon: The Social Mechanisms of Cooperation Among Peers in a Corporate Law Partnership, Oxford University Press (2001).

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D. Lusseau, K. Schneider, O. J. Boisseau, P. Haase, E. Slooten, and S. M. Dawson, Behavioral Ecology and Sociobiology 54, 396-405 (2003).

MacRae J. (1960). Direct factor analysis of sociometric data. Sociometry, 23, 360-371.

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CIDnetworks-gibbs      *CIDnetworks: Bayesian Inference*

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## Description

Usage of CID Gibbs Samplers.

## Usage

```

CID.Gibbs (input,
           outcome,
           node.names,
           components,
           class.outcome = NULL,
           fill.in.missing.edges = missing(outcome),
           new.chain = FALSE,

           draws = 100,
           burnin = -1,
           thin = 10,
           report = 100,
           auto.converge = FALSE,
           extend.max=10,
           extend.count=100,
           verbose=2,
           ...)

## S3 method for class 'CID.Gibbs'
print(x, ...)
## S3 method for class 'CID.Gibbs'
summary(object, ...)
## S3 method for class 'CID.Gibbs'
plot(x, ...)
## S3 method for class 'summary.CID.Gibbs'
print(x, ...)

likelihood.plot(x, ...)
intercept.plot(x, mode = c("standard","trace"), ...)
COV.plot(x, mode = c("standard","trace","scatterplot"), ...)
LSM.plot(x, ...)
SBM.plot(x, ...)
MMSBM.plot(x, ...)
SR.plot(x, ...)

network.plot (x, fitted.values=FALSE, ...)
sociogram.plot (x, component.color=0, vertexcolor, add.labels = TRUE, ...)

```

```

n.nodes(object)
edge.list(object)
is.net.directed(object)
net.density(object)
outcome(object)
node.names(object)
inDegree(object)
outDegree(object)
socio(object)
value.mat(CID.Gibbs.object, prob = TRUE)
value.mat.mean(object, prob = TRUE)
switcheroo(CID.Gibbs.object)

```

### Arguments

input	An object containing information about the edges in a network. Must be one of the following classes: Matrix, CIDnetwork, or CID.Gibbs. If input is a square matrix, it is assumed to be a sociomatrix. Otherwise a matrix with 2 columns and a number of rows equal to the number of edges is required. Providing a CIDnetwork will use the associated edge.list. Providing a CID.Gibbs object will continue the MCMC chain from the last draw.
outcome	If an edgelist is provided as input and outcome is missing, the edges provided are assumed to be the ones in a binary sociomatrix. Otherwise, an outcome value must be specified for each edge in the edgelist, and any edges not provided are assumed to have no data.
node.names	Names labeling each node in the network.
CID.Gibbs.object	If desired, an existing CID.Gibbs output object can be loaded instead of a new network specification.
components	A list of sub-components, including (COV, HBM, LSM, LVM, MMSBM, SBM, SR).
class.outcome	One of "ordinal" (default, values from 0 to higher integers), "binary" (ordinal in 0 and 1) or "gaussian" (unbounded continuous values). Class is auto-detected if NULL remains in place.
fill.in.missing.edges	If TRUE, the edge list will be augmented with zeroes for all unspecified but possible edges. By default, if an outcome is specified, these edges will not be added.
new.chain	If a CID.Gibbs object is provided, the default value of FALSE will return both the old and new MCMC chain combined. A value of TRUE will drop the old chain completely.
draws	Number of draws to return.

burnin	Number of draws to burnin. A negative value will automatically determine burnin amount.
thin	Amount of draws to thin the chain by.
report	Number of draws between reporting total draws so far.
auto.converge	When true, a Geweke convergence test on log-likelihood to detect convergence.
extend.max	Maximum number of times chain will be extended until it returns without converging.
extend.count	Number of draws to extend chain by if convergence test fails
verbose	Level of output to be displayed while running. A value of 0 will return little or no output. A value of 1 will only notify of warnings of misuse. A value of 2 will report progress of MCMC chain. A value of 3 or higher will report debugging values.
...	Further arguments to be passed to the Gibbs sampler routine or the plot routine. See details for more.
x, object	An object outputted from CID.Gibbs.
mode	Controls which diagnostic plot is made.
fitted.values	If TRUE, plots the fitted tie strength under the Gibbs sampler. If FALSE, plots the network outcomes as entered.
component.color	If non-zero, colors the nodes in the sociogram according to the output of the Gibbs sampler.
vertexcolor	User-passed vertex colors for sociogram.plot .
add.labels	When true, node labels are included on nodes.
trace	If selected, displays the Gibbs sampler trace plot for the intercept rather than a point and interval.
prob	In value.mat, converts the linear predictor value to the probability of a binary edge.

### Details

This is the main routine for running a Gibbs sampler on any of the CID models. See the vignettes for more information.

### Value

CID.Gibbs outputs a list containing a CID object, the results of the Gibbs sampler, and the Deviance Information Criterion estimate for the Gibbs.

### Author(s)

A.C. Thomas <act@acthomas.ca>

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CIDnetworks-helpers     *Functions to aid in the use and construction of CIDnetworks objects*

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## Description

Functions to aid in the use and construction of CIDnetworks objects

## Usage

```
l.diag (nn)
u.diag (nn)
ordinal-maker (vec, cuts=quantile(vec, c(0.25, 0.5, 0.75)))

unwrap.CID.Gibbs (gibbs.out)
mat.cov.to.edge.list.cov (Xmat, n.nodes = dim(Xmat)[1],
                          arc.list = make.arc.list(n.nodes))
```

## Arguments

nn	The number of rows in the square matrix for which we wish to extract the lower or upper diagonal matrix.
vec	The elements to be divided into ordinal categories.
cuts	The cut points at which to divide vec into ordinal categories. Default values separate vec into quartiles.
gibbs.out	The list object of draws from the Gibbs sampler. This re-sorts the object into a matrix form for easier consumption.
Xmat	A three-dimensional array of covariates, with n.nodes rows and columns. Each slice is a different covariate.
n.nodes	Number of nodes in network
arc.list	List of potential edges in network.

## Details

These functions are included for the convenience of users of CIDnetworks. l.diag and u.diag provide the indices of a matrix to extract the lower and upper diagonal elements. ordinal-maker will turn any numeric vector into a series of ordinal integers for easy use in a CIDnetworks outcome. Xmat converts a sociomatrix-style array of covariates into one that can easily be used by the COV() component.

## Author(s)

A.C. Thomas <act@acthomas.ca>

**Description**

Usage of the CID main class.

**Usage**

```
CID (input, outcome, n.nodes, node.names, intercept = 0, components,
class.outcome="ordinal", fill.in.missing.edges=missing(outcome),
generate=FALSE, verbose=2, ...)
CID.generate (...)
```

**Arguments**

input	A matrix object containing information about the edges in a network. If the input is a matrix with 2 columns the input is assumed to be a set of edges. If input is a square matrix, it is assumed to be a sociomatrix. If no input is provided, a new network is generated containing n.nodes.
outcome	A set of outcome values for each edge in the edgelist given as input. If outcome is missing, the edgelist is assumed to represent observed edges in a binary network. outcome requires no value is a sociomatrix is provided.
n.nodes	Number of nodes in generated networks
node.names	Names labeling each node in the network.
intercept	Intercept to be used when generating new networks
components	A list of components to use when generating new networks. Possible components include SR, SBM, MMSBM, LSM, LVM HBM EdgeCOV, SenderCOV, ReceiverCOV, SendRecCov, IdenticalCOV
class.outcome	One of "ordinal" (default, values from 0 to higher integers), "binary" (ordinal in 0 and 1) or "gaussian" (unbounded continuous values). Class is auto-detected if NULL remains in place.
fill.in.missing.edges	If TRUE, the edge list will be augmented with zeroes for all unspecified but possible edges. By default, if an outcome is specified, these edges will not be added.
generate	When TRUE a new network with n.nodes nodes is generated as specified by the intercept and components passed to CID.
verbose	Level of output to be displayed while running. A value of 0 will return little or no output. A value of 1 will only notify of warnings of misuse. A value of 2 will report progress of MCMC chain. A value of 3 or higher will report debugging values.
...	Arguments passed to the master class.

**Details**

CID generates a CIDNetwork object that can be passed to many of the plotting and examination methods in the CIDNetworks package. Initial conversion of network data in standard edgelist or sociomatrix form allows easier manipulation within the CIDNetworks framework.

CID can also be used to simulate networks from any of the models that CIDNetworks can fit. CID.generate is a simple wrapper which calls CID with generate = TRUE.

**Value**

A CIDnetwork object.

**Author(s)**

A.C. Thomas <act@acthomas.ca>

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