

# Package ‘collpcm’

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**Version** 1.4

**Type** Package

**Title** Collapsed Latent Position Cluster Model for Social Networks

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**Description** Markov chain Monte Carlo based inference routines for collapsed latent position cluster models or social networks, which includes searches over the model space (number of clusters in the latent position cluster model). The label switching algorithm used is that of Noble and Fearnside (2007) <[doi:10.1007/s11222-006-9014-7](https://doi.org/10.1007/s11222-006-9014-7)> which relies on the algorithm of Carpaneto and Toth (1980) <[doi:10.1145/355873.355883](https://doi.org/10.1145/355873.355883)>.

**Depends** R (>= 2.10), network, latentnet, gtools

**License** GPL-3

**NeedsCompilation** yes

**Maintainer** Jason Wyse <[wyseja@tcd.ie](mailto:wyseja@tcd.ie)>

**Author** Jason Wyse [aut, cre],  
Caitriona Ryan [aut],  
Nial Friel [ths]

**Repository** CRAN

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collpcm.control      *Specify parameters determining the collapsed LPCM model and MCMC fitting run*

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### Description

Specify the number of samples to be collected, burn in to be used, sub-sampling interval, whether variable model jumps are allowed, and whether to run a pilot sample in the initial model.

### Usage

```
collpcm.control( x = list() , n, d )
```

### Arguments

x	An optional list setting the set up parameters of the model. Any parameters not set in the list will default to the values described below.
n	The number of nodes in the network.
d	The dimension of the latent space for model fitting.

### Value

`collpcm.control` returns a list giving the set up of the problem containing the following items:

G	Initial value of G for the chain.
Gmax	The maximum allowed value of G if doing model search.
Gprior	Log of the prior mass on the number of components G.
xi	Mean of the prior on the model intercept.
psi	Standard deviation of the prior on the model intercept.
gamma	Twice the rate of the Gamma prior on the cluster precision.
delta	Twice the shape of the Gamma prior on the cluster precision.
alpha	The parameter of the Dirichlet prior on group weights.
kappa	The scaling of the prior mean for the cluster centre (in units of cluster precision).
betainit	Initial value given to the intercept for the MCMC run.
Xinit	Initial configuration of latent positions for the MCMC run.
sample	Number of MCMC samples to be stored.
burn	Number of MCMC iterations to discard as burn-in.
interval	Number of iterations at which to sub-sample the chain and store i.e. total iterations post burn-in is sample*interval.
model.search	Logical; if TRUE (default) the model space for G is searched.
pilot	Number of iterations to run as a pilot to adapt the proposal standard deviations for the MCMC chains (in addition to adaptation during burn-in).

sd.beta.prop	Standard deviation of the random walk proposal updating the intercept.
sd.X.prop	Standard deviation of the (possibly multivariate) random walk proposal for an actor's latent position.
gamma.update	Logical; if TRUE (default) then the gamma hyperparameter is updated as part of the MCMC run.
store.sparse	Logical; do a sparse form of storage and don't return or store some of the MCMC run and only keep summary values.
adapt	Logical; if TRUE (default) use an adaptive phase during burn-in to tune the standard deviation of the proposals to get an "optimal" acceptance rate.
adapt.interval	The number of iterations between tweaks of the proposal standard deviations in the adaptation phase.
MKL	Logical; if TRUE (default) compute the maximum Kullback-Liebler configuration of the latent positions from Handcock, Raftery & Tantrum (2007)
verbose	Logical; if TRUE (default) print out progression messages throughout the MCMC run and stages of fitting.

**Author(s)**

Jason Wyse

**References**

Ryan, C., Wyse, J. and Friel, N. (2017) *Bayesian model selection for the latent position cluster model for Social Networks*. Network Science, volume 5, 70-91.

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collpcm.fit

*Fit a latent position cluster network model with model search*

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**Description**

`collpcm.fit` is used to fit the latent position cluster model with uncertainty in the number of clusters incorporated. A posterior distribution for the number of clusters is estimated.

**Usage**

```
collpcm.fit( Y , d = 2, G = NULL, Gmax = NULL, control = list(), Xref = NA )
```

**Arguments**

Y	A network object containing the network in question.
d	The dimension of the latent position to represent each node in the network (defaults to 2).
G	Give the initial number of groups for the algorithm.
Gmax	Give the maximum allowed number of groups if doing model search.
control	List giving the set up of the algorithm (see <code>collpcm.control</code> )
Xref	Optional latent positions to be used as a reference configuration for the Procrustes rotations.

**Value**

`collpcm.fit` returns an object of class `collpcm` that is a list. The list will have the following slots.

<code>call</code>	The values of each of the arguments used in the model fitting MCMC run.
<code>sample</code>	A list containing the samples from the MCMC run.
<code>Gpost</code>	Estimated posterior distribution of the number of groups/clusters.
<code>Xpostmean</code>	Estimated posterior mean from sampled latent positions.
<code>XpostMKL</code>	MKL posterior latent positions as described in Handcock, Raftery & Tantrum (2007).
<code>Gslot</code>	An indexing vector for the lists of posterior mean and MKL positions.
<code>acceptance.rates</code>	Acceptance rates for different moves of MCMC algorithm.
<code>adapted.sd.prop</code>	The standard deviations of the proposal distributions after the adaptation phase.
<code>timings</code>	A list of timings for each part of the algorithm.

**Author(s)**

Jason Wyse

**References**

Ryan, C., Wyse, J. and Friel, N. (2017). *Bayesian model selection for the latent position cluster model for Social Networks*. *Network Science*, volume 5, 70-91.

Handcock, M. S., Raftery, A. E. and Tantrum, J. (2007). *Model-Based Clustering for Social Networks*. *Journal of the Royal Statistical Society, Series A*, Vol. 170, 301-354 <doi: 10.1111/j.1467-985X.2007.00471.x>

**See Also**

`collpcm.control`

**Examples**

```
# load the Monks data
data(Monks)

# run the model printing run updates to screen
# this is an illustrative example (it should be run for much longer)
z <- collpcm.fit( Monks, G=3, d=2,
control=list( verbose=TRUE, sample=2500, interval=1, burn=500 ) )

# plot of the collpcm object
plot( z )
```

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collpcm.summaryplot    *Make a summary plot of a collpcm run*

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### Description

`collpcm.summaryplot` creates a 2 by 2 summary plot showing traces from the MCMC run as well as the posterior KL positions for the most visited model.

### Usage

```
collpcm.summaryplot( x )
```

### Arguments

x                    An object of class collpcm

### Author(s)

Jason Wyse

### References

Ryan, C., Wyse, J. and Friel N. (2017) *Bayesian model selection for the latent position cluster model for Social Networks*. Network Science, volume 5, 70-91.

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collpcm.undo.label.switching  
*Correct samples of label vectors for label switching.*

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### Description

`collpcm.undo.label.switching` is used to correct sampled label vectors for label switching using the method proposed by Nobile and Fearnside (2007) which relies on the assignment algorithm of Carpaneto and Toth (1980).

### Usage

```
collpcm.undo.label.switching( Z, Gsamp = NULL )
```

### Arguments

Z                    A matrix of dimensions (num samples) by n giving the sampled label vectors for each iteration of the MCMC run.

Gsamp                A vector of length (num samples) giving the corresponding number of groups for each iteration of the MCMC run.

**Value**

`collpcm.undo.label.switching` returns a list with the following slots.

<code>call</code>	The function call.
<code>relab</code>	The post processed Z matrix after label switching has been corrected for
<code>label.probs</code>	List giving the probability of belonging to each group for each item, each entry of the list corresponding to a given number of components.
<code>permutation</code>	The permutation applied to each row to correct for label switching.

**Author(s)**

Jason Wyse

**References**

Nobile, A. and Fearnside A. T. (2007). *Bayesian finite mixtures with an unknown number of components: The allocation sampler* Statistics and Computing, Vol. 17, 147-162 <doi:10.1007/s11222-006-9014-7>

Carpaneto, G. and Toth, P. (1980). *Algorithm 548: Solution of the Assignment Problem [H]* ACM Transactions on Mathematical Software, Vol. 6, 104-111 <doi:10.1145/355873.355883>

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Dolphins

*Dolphins*

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**Description**

Network describing social ties between dolphins off doubtful sound.

**Usage**

```
data(Dolphins)
```

**Source**

Lusseau, D., Schneider, K., Boisseau, O. J., Hasse, P., Slooten, E. and Dawson, S. M. (2003) *The bottlenose dolphin community of Doubtful Sound features a large proportion of long-lasting associations- Can geographic isolation explain this unique trait?* Behavioural Ecology and Sociobiology 54, 396–405.

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Karate	<i>Network describing loyalty in the Karate club.</i>
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**Description**

The well known Karate data.

**Usage**

data(Karate)

**Source**

Zachary, W.-W. (1977) *An information flow model for conflict and fission in small groups*, Journal of Anthropological Research 33, 452-473

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Monks	<i>Monks</i>
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**Description**

Sampson's aggregated Monk's dataset.

**Usage**

data(Monks)

**Source**

Sampson, S.-F. (1968), *A novitiate in a period of change: An experimental and case study of relationships*, Unpublished Ph.D. dissertation, Department of Sociology, Cornell University.

<http://vlado.fmf.uni-lj.si/pub/networks/data/esna/sampson.htm>

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plot.collpcm                      *Plotting a collpcm object*

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### Description

Plot the posterior mean latent positions for G groups.

### Usage

```
## S3 method for class 'collpcm'
plot( x, ..., G = NULL, label.nodes = NULL, pie = TRUE,

      vertex.col = c( "red", "green", "blue", "cyan", "magenta", "orange", "yellow", "purple" ),

      vertex.cex = 1, object.scale = formals(plot.network.default)[["object.scale"]] )
```

### Arguments

x	An object of class collpcm.
...	Additional arguments including.
G	The number of groups in the model to be plotted. Defaults to most visited in MCMC run.
label.nodes	A vector of labels to print beside corresponding nodes on the plot.
pie	Logical; Draw small pie charts to indicate group membership probabilities.
vertex.col	The colour for the slices of pie (previous).
vertex.cex	Magnify the vertex
object.scale	Scale up/down the size of the plotting of vertex and arrows.

### Details

This function gives a plot of the latent positions for a given number of groups (assuming the model with the specified number of groups has been visited during the run of the sampler). If argument `pie` is set to `TRUE`, membership probabilities of the nodes are indicated by pie charts with each colour corresponding to a different group in the model. Some of the code to implement this function draws heavily on code contained in the `latentnet` package (Krivitsky & Handcock, 2015).

### Author(s)

Jason Wyse

**References**

Ryan, C., Wyse, J. and Friel, N. (2017). *Bayesian model selection for the latent position cluster model for Social Networks*. Network Science, volume 5, 70-91.

Krivitsky P and Handcock M (2015). latentnet: Latent Position and Cluster Models for Statistical Networks. The Statnet Project (<http://www.statnet.org>). R package version 2.7.1, <http://CRAN.R-project.org/package=latentnet>.

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print.collpcm	<i>Print a collpcm object</i>
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**Description**

Print a summary of a collpcm object.

**Usage**

```
## S3 method for class 'collpcm'  
print( x, ... )
```

**Arguments**

x	An object of class collpcm.
...	Optional arguments to lower level functions.

**Author(s)**

Jason Wyse

**References**

Ryan, C., Wyse, J. and Friel, N. (2017) *Bayesian model selection for the latent position cluster model for Social Networks*. Network Science, volume 5, 70-91.

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summary.collpcm	<i>Summarize a collpcm object</i>
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**Description**

Print a summary of a collpcm object.

**Usage**

```
## S3 method for class 'collpcm'  
summary( object, ... )
```

**Arguments**

object            An object of class collpcm.  
...                Optional arguments to lower level functions.

**Author(s)**

Jason Wyse

**References**

Ryan, C., Wyse, J. and Friel, N. (2017) *Bayesian model selection for the latent position cluster model for Social Networks*. Network Science, volume 5, 70-91.

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