Package ‘missSBM’

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Type Package
Title Handling Missing Data in Stochastic Block Models
Version 1.0.1
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Description
When a network is partially observed (here, NAs in the adjacency matrix rather than 1 or 0
due to missing information between node pairs), it is possible to account for the underlying process
that generates those NAs. 'missSBM', presented in 'Barbillon, Chi-
quet and Tabouy' (2021) <arXiv:1906.12201>,
adjusts the popular stochastic block model from network data sampled under various miss-
ing data conditions,

URL https://grosssbm.github.io/missSBM/
BugReports https://github.com/grossSBM/missSBM/issues
License GPL-3
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RoxygenNote 7.1.1
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 'RcppExports.R' 'er_network.R' 'estimateMissSBM.R'
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R topics documented:

blockDyadSampler blockDyadSampling_fit blockNodeSampler blockNodeSampling_fit
covarDyadSampling_fit covarNodeSampling_fit
degreeSampler degreeSampling_fit
doubleStandardSampler doubleStandardSampling_fit
dyadSampler dyadSampling_fit
er_network estimateMissSBM fitted.missSBM_fit
frenchblog2007 missSBM missSBM_collection
misSMB_fit
networkSampler networkSampling networkSamplingDyads_fit
networkSamplingNodes_fit
nodeSampler nodeSampling_fit
observeNetwork partlyObservedNetwork
plot.missSBM_fit predicted.missSBM_fit
simpleDyadSampler simpleNodeSampler

R topics documented:
blockDyadSampler

Class for defining a block dyad sampler

Description

Class for defining a block dyad sampler

Super classes

missSBM::networkSampling -> missSBM::networkSampler -> missSBM::dyadSampler -> blockDyadSampler

Active bindings

df the number of parameters of this sampling

Methods

Public methods:

- blockDyadSampler$new()
- blockDyadSampler$clone()

Method new(): constructor for networkSampling

Usage:

blockDyadSampler$new(
  parameters = NA,
  nbNodes = NA,
  directed = FALSE,
  clusters = NA
)

Arguments:

parameters the vector of parameters associated to the sampling at play

nbNodes number of nodes in the network
directed logical, directed network of not

clusters a vector of class memberships

Method clone(): The objects of this class are cloneable with this method.
Usage:
blockDyadSampler$clone(deep = FALSE)

Arguments:
deep Whether to make a deep clone.

blockDyadSampling_fit  Class for fitting a block-dyad sampling

Description
Class for fitting a block-dyad sampling
Class for fitting a block-dyad sampling

Super classes
missSBM::networkSampling -> missSBM::networkSamplingDyads_fit -> blockDyadSampling_fit

Active bindings
vExpec variational expectation of the sampling
log_lambda matrix, term for adjusting the imputation step which depends on the type of sampling

Methods
Public methods:
• blockDyadSampling_fit$new()
• blockDyadSampling_fit$update_parameters()
• blockDyadSampling_fit$clone()

Method new(): constructor
Usage:
blockDyadSampling_fit$new(partlyObservedNetwork, blockInit)

Arguments:
partlyObservedNetwork a object with class partlyObservedNetwork representing the observed
data with possibly missing entries
blockInit n x Q matrix of initial block indicators

Method update_parameters(): a method to update the estimation of the parameters. By
default, nothing to do (corresponds to MAR sampling)

Usage:
blockDyadSampling_fit$update_parameters(nu, Z)

Arguments:
nu the matrix of (uncorrected) imputation for missing entries
**blockNodeSampler**

Z probabilities of block memberships

**Method clone():** The objects of this class are cloneable with this method.

*Usage:*

```r
blockDyadSampling_fit$clone(deep = FALSE)
```

*Arguments:*

- `deep` Whether to make a deep clone.

---

**blockNodeSampler**  
*Class for defining a block node sampler*

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**Description**

Class for defining a block node sampler

Class for defining a block node sampler

**Super classes**

`missSBM::networkSampling` -> `missSBM::networkSampler` -> `missSBM::nodeSampler` -> `blockNodeSampler`

**Methods**

**Public methods:**

- `blockNodeSampler$new()`  
- `blockNodeSampler$clone()`

**Method new():** constructor for `networkSampling`

*Usage:*

```r
blockNodeSampler$new(parameters = NA,  
                      nbNodes = NA,  
                      directed = FALSE,  
                      clusters = NA)
```

*Arguments:*

- `parameters` the vector of parameters associated to the sampling at play
- `nbNodes` number of nodes in the network
- `directed` logical, directed network of not
- `clusters` a vector of class memberships

**Method clone():** The objects of this class are cloneable with this method.

*Usage:*

```r
blockNodeSampler$clone(deep = FALSE)
```

*Arguments:*

- `deep` Whether to make a deep clone.
blockNodeSampling_fit  
Class for fitting a block-node sampling

Description
Class for fitting a block-node sampling

Super classes
missSBM::networkSampling -> missSBM::networkSamplingNodes_fit -> blockNodeSampling_fit

Active bindings
vExpec  variational expectation of the sampling
log_lambda  double, term for adjusting the imputation step which depends on the type of sampling

Methods

Public methods:
• blockNodeSampling_fit$new()
• blockNodeSampling_fit$update_parameters()
• blockNodeSampling_fit$clone()

Method new(): constructor
Usage:
blockNodeSampling_fit$new(partlyObservedNetwork, blockInit)
Arguments:
partlyObservedNetwork  a object with class partlyObservedNetwork representing the observed
data with possibly missing entries
blockInit  n x Q matrix of initial block indicators

Method update_parameters(): a method to update the estimation of the parameters. By
default, nothing to do (corresponds to MAR sampling)
Usage:
blockNodeSampling_fit$update_parameters(imputedNet, Z)
Arguments:
imputedNet  an adjacency matrix where missing values have been imputed
Z  indicator of blocks

Method clone(): The objects of this class are cloneable with this method.
Usage:
blockNodeSampling_fit$clone(deep = FALSE)
Arguments:
deep  Whether to make a deep clone.
**coef.missSBM_fit**  

*Extract model coefficients*

**Description**

Extracts model coefficients from objects `missSBM_fit` returned by `estimateMissSBM()`.

**Usage**

```r
## S3 method for class 'missSBM_fit'
coef(
  object,
  type = c("mixture", "connectivity", "covariates", "sampling"),
  ...
)
```

**Arguments**

- `object`: an R6 object with class `missSBM_fit`
- `type`: type of parameter that should be extracted. Either "mixture" (default), "connectivity", "covariates" or "sampling"
- `...`: additional parameters for S3 compatibility. Not used

**Value**

A vector or matrix of coefficients extracted from the `missSBM_fit` model.

---

**covarDyadSampling_fit**  

*Class for fitting a dyad sampling with covariates*

**Description**

Class for fitting a dyad sampling with covariates

**Super classes**

```
missSBM::networkSampling -> missSBM::networkSamplingDyads_fit -> covarDyadSampling_fit
```

**Active bindings**

- `vExpec` variational expectation of the sampling
Methods

Public methods:
• covarDyadSampling_fit$new()
• covarDyadSampling_fit$clone()

Method new(): constructor
Usage:
covarDyadSampling_fit$new(partialNet, ...)
Arguments:
partialNet a object with class partlyObservedNetwork representing the observed data with possibly missing entries
... used for compatibility

Method clone(): The objects of this class are cloneable with this method.
Usage:
covarDyadSampling_fit$clone(deep = FALSE)
Arguments:
dee0 Whether to make a deep clone.

covarNodeSampling_fit  Class for fitting a node-centered sampling with covariate

Description
Class for fitting a node-centered sampling with covariate
Class for fitting a node-centered sampling with covariate

Super classes
missSBM::networkSampling -> missSBM::networkSamplingNodes_fit -> covarNodeSampling_fit

Active bindings
vExpec variational expectation of the sampling

Methods

Public methods:
• covarNodeSampling_fit$new()
• covarNodeSampling_fit$clone()

Method new(): constructor
Usage:
covarNodeSampling_fit$new(partlyObservedNetwork, ...)

Arguments:
partlyObservedNetwork  a object with class partlyObservedNetwork representing the observed
    data with possibly missing entries
... used for compatibility

Method clone(): The objects of this class are cloneable with this method.

Usage:
covarNodeSampling_fit$clone(deep = FALSE)

Arguments:
deep  Whether to make a deep clone.

---

degreeSampler  

Class for defining a degree sampler

Description

Class for defining a degree sampler

Super classes

missSBM::networkSampling -> missSBM::networkSampler -> missSBM::nodeSampler -> degreeSampler

Methods

Public methods:

• degreeSampler$new()
• degreeSampler$clone()

Method new(): constructor for networkSampling

Usage:
degreeSampler$new(parameters = NA, degrees = NA, directed = FALSE)

Arguments:
parameters  the vector of parameters associated to the sampling at play
degrees  vector of nodes’ degrees
directed  logical, directed network of not

Method clone(): The objects of this class are cloneable with this method.

Usage:
degreeSampler$clone(deep = FALSE)

Arguments:
deep  Whether to make a deep clone.
**degreeSampling_fit**  
Class for fitting a degree sampling

---

**Description**

Class for fitting a degree sampling

**Super classes**

missSBM::networkSampling -> missSBM::networkSamplingNodes_fit -> degreeSampling_fit

**Active bindings**

vExpec  variational expectation of the sampling

**Methods**

**Public methods:**

- `degreeSampling_fit$new()`
- `degreeSampling_fit$update_parameters()`
- `degreeSampling_fit$update_imputation()`
- `degreeSampling_fit(clone)`

**Method** `new()`: constructor

*Usage:*

```
degreeSampling_fit$new(partlyObservedNetwork, blockInit, connectInit)
```

*Arguments:*

- `partlyObservedNetwork`: a object with class partlyObservedNetwork representing the observed data with possibly missing entries
- `blockInit`: n x Q matrix of initial block indicators
- `connectInit`: Q x Q matrix of initial block probabilities of connection

**Method** `update_parameters()`: a method to update the estimation of the parameters. By default, nothing to do (corresponds to MAR sampling)

*Usage:*

```
degreeSampling_fit$update_parameters(imputedNet, ...)
```

*Arguments:*

- `imputedNet`: an adjacency matrix where missing values have been imputed

**Method** `update_imputation()`: a method to update the imputation of the missing entries.

*Usage:*

```
degreeSampling_fit$update_imputation(PI, ...)
```
**doubleStandardSampler**

*Arguments:*

- $P_I$ the matrix of inter/intra class probability of connection
- ... use for compatibility

*Method* `clone()`: The objects of this class are cloneable with this method.

*Usage:*

```r
degreeSampling_fit$clone(deep = FALSE)
```

*Arguments:*

- `deep` Whether to make a deep clone.

---

**Class for defining a double-standard sampler**

**Description**

Class for defining a double-standard sampler

**Super classes**

`missSBM::networkSampling` -> `missSBM::networkSampler` -> `missSBM::dyadSampler` -> `doubleStandardSampler`

**Methods**

**Public methods:**

- `doubleStandardSampler$new()`
- `doubleStandardSampler$clone()`

*Method* `new()`: constructor for networkSampling

*Usage:*

```r
doubleStandardSampler$new(parameters = NA, adjMatrix = NA, directed = FALSE)
```

*Arguments:*

- `parameters` the vector of parameters associated to the sampling at play
- `adjMatrix` matrix of adjacency
- `directed` logical, directed network of not

*Method* `clone()`: The objects of this class are cloneable with this method.

*Usage:*

```r
doubleStandardSampler$clone(deep = FALSE)
```

*Arguments:*

- `deep` Whether to make a deep clone.
**doubleStandardSampling_fit**

*Class for fitting a double-standard sampling*

---

**Description**

Class for fitting a double-standard sampling

Class for fitting a double-standard sampling

**Super classes**

missSBM::networkSampling -> missSBM::networkSamplingDyads_fit -> doubleStandardSampling_fit

**Active bindings**

vExpec variational expectation of the sampling

**Methods**

**Public methods:**

- `doubleStandardSampling_fit$new()`  
- `doubleStandardSampling_fit$update_parameters()`  
- `doubleStandardSampling_fit$update_imputation()`  
- `doubleStandardSampling_fit$clone()`

**Method new():** constructor  

*Usage:*

doubleStandardSampling_fit$new(partlyObservedNetwork, ...)

*Arguments:*

- partlyObservedNetwork a object with class partlyObservedNetwork representing the observed data with possibly missing entries
- ... used for compatibility

**Method update_parameters():** a method to update the estimation of the parameters. By default, nothing to do (corresponds to MAR sampling)  

*Usage:*

doubleStandardSampling_fit$update_parameters(nu, ...)

*Arguments:*

- nu an adjacency matrix with imputed values (only)
- ... use for compatibility

**Method update_imputation():** a method to update the imputation of the missing entries.  

*Usage:*

doubleStandardSampling_fit$update_imputation(nu)
dyadSampler

*Arguments:*  
nu the matrix of (uncorrected) imputation for missing entries

**Method clone():** The objects of this class are cloneable with this method.  
*Usage:*  
doubleStandardSampling_fit$clone(deep = FALSE)  
*Arguments:*  
deep Whether to make a deep clone.

---

**Description**  
Virtual class for all dyad-centered samplers

**Super classes**  
missSBM::networkSampling -> missSBM::networkSampler -> dyadSampler

**Methods**

**Public methods:**  
- dyadSampler$new()  
- dyadSampler$clone()

**Method new():** constructor for networkSampling  
*Usage:*  
dyadSampler$new(type = NA, parameters = NA, nbNodes = NA, directed = FALSE)  
*Arguments:*  
type character for the type of sampling. must be in ("dyad", "covar-dyad", "node", "covar-node", "block-node", "block-dyad", "double-standard", "degree")  
parameters the vector of parameters associated to the sampling at play  
nbNodes number of nodes in the network  
directed logical, directed network of not

**Method clone():** The objects of this class are cloneable with this method.  
*Usage:*  
dyadSampler$clone(deep = FALSE)  
*Arguments:*  
deep Whether to make a deep clone.
dyadSampling_fit

Class for fitting a dyad sampling

Description

Class for fitting a dyad sampling

Super classes

missSBM::networkSampling -> missSBM::networkSamplingDyads_fit -> dyadSampling_fit

Active bindings

vExpec  variational expectation of the sampling

Methods

Public methods:

- dyadSampling_fit$new()
- dyadSampling_fit$clone()

Method new(): constructor

Usage:
dyadSampling_fit$new(partlyObservedNetwork, ...)

Arguments:
partlyObservedNetwork  a object with class partlyObservedNetwork representing the observed data with possibly missing entries
...  used for compatibility

Method clone(): The objects of this class are cloneable with this method.

Usage:
dyadSampling_fit$clone(deep = FALSE)

Arguments:
deep  Whether to make a deep clone.
**er_network**  

*ER ego centered network*

**Description**

A dataset containing the weighted PPI network centered around the ESR1 (ER) protein.

**Usage**

```
er_network
```

**Format**

A sparse symmetric matrix with 741 rows and 741 columns.

**Source**

[https://string-db.org/](https://string-db.org/)

**Examples**

```
data("er_network")
class(er_network)
```

---

**estimateMissSBM**  

*Estimation of simple SBMs with missing data*

**Description**

Variational EM inference of Stochastic Block Models indexed by block number from a partially observed network.

**Usage**

```
estimateMissSBM(
  adjacencyMatrix,
  vBlocks,
  sampling,
  covariates = list(),
  control = list()
)
```
**Arguments**

**adjacencyMatrix**

The N x N adjacency matrix of the network data. If `adjacencyMatrix` is symmetric, we assume an undirected network with no loop; otherwise the network is assumed to be directed.

**vBlocks**

The vector of number of blocks considered in the collection.

**sampling**

The model used to described the process that originates the missing data: MAR designs ("dyad", "node","covar-dyad","covar-node","snowball") and MNAR designs ("double-standard", "block-dyad", “block-node”, "degree") are available. See details.

**covariates**

An optional list with M entries (the M covariates). If the covariates are node-centered, each entry of `covariates` must be a size-N vector; if the covariates are dyad-centered, each entry of `covariates` must be N x N matrix.

**control**

A list of parameters controlling advanced features. See details.

**Details**

Internal functions use `future_lapply`, so set your plan to `multisession` or `multicore` to use several cores/workers. The list of parameters `control` tunes more advanced features, such as the initialization, how covariates are handled in the model, and the variational EM algorithm:

- "useCov": logical. If `covariates` is not null, should they be used for the for the SBM inference (or just for the sampling)? Default is TRUE.
- "clusterInit": Initial method for clustering: either a character ("spectral") or a list with length(vBlocks) vectors, each with size ncol(adjacencyMatrix), providing a user-defined clustering. Default is "spectral".
- "similarity": An R x R -> R function to compute similarities between node covariates. Default is `missSBM:::l1_similarity`, that is, -abs(x-y). Only relevant when the covariates are node-centered (i.e. covariates is a list of size-N vectors).
- "threshold": V-EM algorithm stops stop when an optimization step changes the objective function or the parameters by less than threshold. Default is 1e-2.
- "maxIter": V-EM algorithm stops when the number of iteration exceeds maxIter. Default is 50.
- "fixPointIter": number of fix-point iterations in the V-E step. Default is 3.
- "exploration": character indicating the kind of exploration used among "forward", "backward", "both" or "none". Default is "both".
- "iterates": integer for the number of iterations during exploration. Only relevant when exploration is different from "none". Default is 1.
- "trace": logical for verbosity. Default is TRUE.

The different sampling designs are split into two families in which we find dyad-centered and node-centered samplings. See doi: 10.1080/01621459.2018.1562934 for a complete description.

- Missing at Random (MAR)
  - "dyad": parameter = p = Prob(Dyad(i,j) is observed)
estimateMissSBM

- "node": parameter = p = Prob(Node i is observed)
- "covar-dyad": parameter = beta in R^M, such that Prob(Dyad (i,j) is observed) = logistic(parameter' covarArray (i,j, .))
- "covar-node": parameter = nu in R^M such that Prob(Node i is observed) = logistic(parameter' covarMatrix (i, )
- "snowball": parameter = number of waves with Prob(Node i is observed in the 1st wave)

Missing Not At Random (MNAR)
- "double-standard": parameter = (p0,p1) with p0 = Prob(Dyad (i,j) is observed | the dyad is equal to 0), p1 = Prob(Dyad (i,j) is observed | the dyad is equal to 1)
- "block-node": parameter = c(p(1),...,p(Q)) and p(q) = Prob(Node i is observed | node i is in cluster q)
- "block-dyad": parameter = c(p(1,1),...,p(Q,Q)) and p(q,l) = Prob(Edge (i,j) is observed | node i is in cluster q and node j is in cluster l)
- "degree": parameter = c(a,b) and logit(a+b*degree(i)) = Prob(Node i is observed | Degree(i))

Value

Returns an R6 object with class missSBM_collection.

See Also

observeNetwork, missSBM_collection and missSBM_fit.

Examples

```r
## SBM parameters
N <- 100 # number of nodes
Q <- 3 # number of clusters
pi <- rep(1,Q)/Q # block proportion
theta <- list(mean = diag(.45,Q) + .05 ) # connectivity matrix

## Sampling parameters
samplingParameters <- .75 # the sampling rate
sampling <- "dyad" # the sampling design

## generate a undirected binary SBM with no covariate
sbm <- sbm::sampleSimpleSBM(N, pi, theta)

## Uncomment to set parallel computing with future
## future::plan("multicore", workers = 2)

## Sample some dyads data + Infer SBM with missing data
collection <-
  observeNetwork(sbm$networkData, sampling, samplingParameters) %>%
  estimateMissSBM(vBlocks = 1:5, sampling = sampling)
plot(collection, "monitoring")
plot(collection, "icl")

collection$ICL
```
```r
coeff(collection$bestModel$fittedSBM, "connectivity")
myModel <- collection$bestModel
plot(myModel, "expected")
plot(myModel, "imputed")
plot(myModel, "meso")
coeff(myModel, "sampling")
coeff(myModel, "connectivity")
predict(myModel)[1:5, 1:5]
```

### fitted.missSBM_fit

**Extract model fitted values from object missSBM_fit, return by estimateMissSBM()**

### Description

Extract model fitted values from object *missSBM_fit*, return by *estimateMissSBM()*

### Usage

```r
## S3 method for class 'missSBM_fit'
fitted(object, ...)
```

### Arguments

- `object` an R6 object with class *missSBM_fit*
- `...` additional parameters for S3 compatibility.

### Value

A matrix of estimated probabilities of connection

### frenchblog2007

**Political Blogosphere network prior to 2007 French presidential election**

### Description

French Political Blogosphere network dataset consists of a single day snapshot of over 200 political blogs automatically extracted the 14 October 2006 and manually classified by the "Observatoire Présidentielle" project. Originally part of the 'mixer' package

### Usage

`frenchblog2007`
**Format**

An igraph object with 196 nodes. The vertex attribute "party" provides a possible clustering of the nodes.

**Source**

https://www.linkfluence.com/

**Examples**

```r
data(frenchblog2007)
igraph::V(frenchblog2007)$party
igraph::plot.igraph(frenchblog2007,
  vertex.color = factor(igraph::V(frenchblog2007)$party),
  vertex.label = NA
)
```

---

**Description**

The missSBM package provides the following top-level functions functions:

- `observeNetwork`: a function to draw a partially observe network from an existing, fully observed network according to a variety of sampling designs
- `estimateMissSBM`: a function to perform inference of SBM from a partially observed under various sampling designs.

**Details**

These function leads to the manipulation of a variety of R objects instantiated from some R6 classes, with their respective fields and methods. They are all generated by the top-level functions itemized above, so that the user should generally not use their constructor or internal methods directly. The user should only have a basic understanding of the fields of each object to manipulate the output in R. The main objects are the following:

- `missSBM_fit`: an object that put together an SBM fit and and network sampling fit - the main point of the missSBM package!
- `missSBM_collection`: an object to store a collection of missSBM_fit, ordered by number of block
- `SimpleSBM_fit_MNAR`: an object to define and store an SBM fit with MNAR values
- `SimpleSBM_fit_noCov`: an object to define and store an SBM fit without covariate, MAR values
- `SimpleSBM_fit_withCov`: an object to define and store an SBM fit with covariates, MAR values
missSBM_collection

- **networkSampling**: an object to define and store a network sampling fit

missSBM extends some functionality of the package sbm, by inheriting from classes and methods associated to simple stochastic block models.

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**References**


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**missSBM_collection**  
An R6 class to represent a collection of SBM fits with missing data

---

**Description**

The function `estimateMissSBM()` fits a collection of SBM with missing data for a varying number of block. These models with class `missSBM_fit` are stored in an instance of an object with class `missSBM_collection`, described here.

Fields are accessed via active binding and cannot be changed by the user.

This class comes with a set of R6 methods, some of them being useful for the user and exported as S3 methods. See the documentation for `show()` and `print()`

**Active bindings**

- `models` a list of models
- `ICL` the vector of Integrated Classification Criterion (ICL) associated to the models in the collection (the smaller, the better)
- `bestModel` the best model according to the ICL
- `vBlocks` a vector with the number of blocks
- `optimizationStatus` a data.frame summarizing the optimization process for all models

**Methods**

**Public methods:**

- `missSBM_collection$new()`
- `missSBM_collection$estimate()`
- `missSBM_collection$explore()`
- `missSBM_collection$plot()`
Method `new()`: constructor for `networkSampling`

Usage:
missSBM_collection$new(partlyObservedNet, sampling, clusterInit, control)

Arguments:
- `partlyObservedNet`: An object with class `partlyObservedNetwork`.
- `sampling`: The sampling design for the modelling of missing data: MAR designs ("dyad", "node") and MNAR designs ("double-standard", "block-dyad", "block-node", "degree").
- `clusterInit`: Initial clustering: a list of vectors, each with size `ncol(adjacencyMatrix)`.
- `control`: a list of parameters controlling advanced features. Only 'trace' and 'useCov' are relevant here. See `estimateMissSBM()` for details.

Method `estimate()`: method to launch the estimation of the collection of models

Usage:
missSBM_collection$estimate(control)

Arguments:
- `control`: a list of parameters controlling the variational EM algorithm. See details of function `estimateMissSBM()`

Method `explore()`: method for performing exploration of the ICL

Usage:
missSBM_collection$explore(control)

Arguments:
- `control`: a list of parameters controlling the exploration, similar to those found in the regular function `estimateMissSBM()`

Method `plot()`: plot method for `missSBM_collection`

Usage:
missSBM_collection$plot(type = c("icl", "elbo", "monitoring"))

Arguments:
- `type`: the type specifies the field to plot, either "icl", "elbo" or "monitoring". Default is "icl"

Method `show()`: show method for `missSBM_collection`

Usage:
missSBM_collection$show()

Method `print()`: User friendly print method

Usage:
missSBM_collection$print()

Method `clone()`: The objects of this class are cloneable with this method.

Usage:
missSBM_collection$clone(deep = FALSE)

Arguments:
- `deep`: Whether to make a deep clone.
Examples

```r
## Uncomment to set parallel computing with future
## future::plan("multicore", workers = 2)

## Sample 75% of dyads in French political Blogosphere's network data
adjacencyMatrix <- missSBM::frenchblog2007 %>%
  igraph::delete.vertices(1:100) %>%
  igraph::as_adj() %>%
  missSBM::observeNetwork(sampling = "dyad", parameters = 0.75)
collection <- estimateMissSBM(adjacencyMatrix, 1:5, sampling = "dyad")
class(collection)
```

---

**missSBM_fit**

*An R6 class to represent an SBM fit with missing data*

---

**Description**

The function `estimateMissSBM()` fits a collection of SBM for varying number of block. Each fitted SBM is an instance of an R6 object with class `missSBM_fit`, described here.

Fields are accessed via active binding and cannot be changed by the user.

This class comes with a set of R6 methods, some of them being useful for the user and exported as S3 methods. See the documentation for `show()`, `print()`, `fitted()`, `predict()`, `plot()`.

**Active bindings**

- `fittedSBM` the fitted SBM with class `SimpleSBM_fit_noCov`, `SimpleSBM_fit_withCov` or `SimpleSBM_fit_MNAR` inheriting from class `sbm::SimpleSBM_fit`
- `fittedSampling` the fitted sampling, inheriting from class `networkSampling` and corresponding fits
- `imputedNetwork` The network data as a matrix with NAs values imputed with the current model
- `monitoring` a list carrying information about the optimization process
- `entropyImputed` the entropy of the distribution of the imputed dyads
- `entropy` the entropy due to the distribution of the imputed dyads and of the clustering
- `vExpec` double: variational expectation of the complete log-likelihood
- `penalty` double, value of the penalty term in ICL
- `loglik` double: approximation of the log-likelihood (variational lower bound) reached
- `ICL` double: value of the integrated classification log-likelihood
**missSBM_fit**

### Methods

**Public methods:**

- `missSBM_fit$new()`
- `missSBM_fit$doVEM()`
- `missSBM_fit$show()`
- `missSBM_fit$print()`
- `missSBM_fit$clone()`

**Method new():** constructor for networkSampling

*Usage:*

```r
missSBM_fit$new(partlyObservedNet, netSampling, clusterInit, useCov = TRUE)
```

*Arguments:*

- `partlyObservedNet` An object with class `partlyObservedNetwork`.
- `netSampling` The sampling design for the modelling of missing data: MAR designs ("dyad", "node") and MNAR designs ("double-standard", "block-dyad", "block-node", "degree")
- `clusterInit` Initial clustering: a vector with size `ncol(adjacencyMatrix)`, providing a user-defined clustering. The number of blocks is deduced from the number of levels in with `clusterInit`.
- `useCov` logical. If covariates are present in partlyObservedNet, should they be used for the inference or of the network sampling design, or just for the SBM inference? default is TRUE.

**Method doVEM():** a method to perform inference of the current missSBM fit with variational EM

*Usage:*

```r
missSBM_fit$doVEM(  
  control = list(threshold = 0.01, maxIter = 100, fixPointIter = 3, trace = TRUE)  
)
```

*Arguments:*

- `control` a list of parameters controlling the variational EM algorithm. See details of function `estimateMissSBM()`

**Method show():** show method for missSBM_fit

*Usage:*

```r
missSBM_fit$show()
```

**Method print():** User friendly print method

*Usage:*

```r
missSBM_fit$print()
```

**Method clone():** The objects of this class are cloneable with this method.

*Usage:*

```r
missSBM_fit$clone(deep = FALSE)
```

*Arguments:*

- `deep` Whether to make a deep clone.
## Sample 75% of dyads in French political Blogosphere's network data

```r
definition <- missSBM::frenchblog2007 %>%
  igraph::as_adj (sparse = FALSE) %>%
  missSBM::observeNetwork(sampling = "dyad", parameters = 0.75)
collection <- estimateMissSBM(adjMatrix, 3:5, sampling = "dyad")
my_missSBM_fit <- collection$bestModel
class(my_missSBM_fit)
plot(my_missSBM_fit, "imputed")
```

### Definition of R6 Class `networkSampling_sampler`

**Description**

Definition of R6 Class 'networkSampling_sampler'

**Details**

This class is used to define a sampling model for a network. Inheriting from 'networkSampling'. Owns a `rSampling` method which takes an adjacency matrix as an input and sends back an object with class `partlyObservedNetwork`.

**Super class**

`missSBM::networkSampling` -> `networkSampler`

**Active bindings**

- `samplingMatrix` a matrix of logical indicating observed entries

**Methods**

**Public methods:**

- `networkSampler$new()`
- `networkSampler$rSamplingMatrix()`
- `networkSampler$clone()`

**Method `new()`**: constructor for `networkSampling`

**Usage**:

`networkSampler$new(type = NA, parameters = NA, nbNodes = NA, directed = FALSE)`

**Arguments**:

type character for the type of sampling. must be in ("dyad", "covar-dyad", "node", "covar-node", "block-node", "block-dyad", "double-standard", "degree")
**networkSampling**

- **parameters**: the vector of parameters associated to the sampling at play
- **nbNodes**: number of nodes in the network
- **directed**: logical, directed network of not

**Method** `rSamplingMatrix()`: a method for drawing a sampling matrix according to the current sampling design

*Usage:*  
`networkSampler$rSamplingMatrix()`

**Method** `clone()`: The objects of this class are cloneable with this method.

*Usage:*  
`networkSampler$clone(deep = FALSE)`

*Arguments:*
  - **deep**: Whether to make a deep clone.

**See Also**

- `partlyObservedNetwork`

---

**networkSampling**  

**Definition of R6 Class ‘networkSampling’**

**Description**

Definition of R6 Class 'networkSampling'

Definition of R6 Class 'networkSampling'

**Details**

This virtual class is the mother of all subtypes of `networkSampling` (either sampler or fit). It is used to define a sampling model for a network. It has a `rSampling` method which takes an adjacency matrix as an input and send back an object with class `partlyObservedNetwork`.

**Active bindings**

- **type**: a character for the type of sampling
- **parameters**: the vector of parameters associated with the sampling at play
- **df**: the number of entries in the vector of parameters
Methods

Public methods:

- `networkSampling$new()`
- `networkSampling$show()`
- `networkSampling$print()`
- `networkSampling$clone()`

Method `new()`: constructor for `networkSampling`

Usage:

```r
networkSampling$new(type = NA, parameters = NA)
```

Arguments:

- `type` character for the type of sampling. must be in ("dyad", "covar-dyad", "node", "covar-node", "block-node", "block-dyad", "double-standard", "degree")
- `parameters` the vector of parameters associated to the sampling at play

Method `show()`: show method

Usage:

```r
networkSampling$show(type = paste0(private$name, "-model for network sampling\n"))
```

Arguments:

- `type` character used to specify the type of sampling

Method `print()`: User friendly print method

Usage:

```r
networkSampling$print()
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```r
networkSampling$clone(deep = FALSE)
```

Arguments:

- `deep` Whether to make a deep clone.

---

networkSamplingDyads_fit

Virtual class used to define a family of `networkSamplingDyads_fit`

Description

Virtual class used to define a family of `networkSamplingDyads_fit`
**Super class**

`missSBM::networkSampling` -> `networkSamplingDyads_fit`

**Active bindings**

- `penalty` double, value of the penalty term in ICL
- `log_lambda` double, term for adjusting the imputation step which depends on the type of sampling

**Methods**

**Public methods:**

- `networkSamplingDyads_fit$new()`
- `networkSamplingDyads_fit$show()`
- `networkSamplingDyads_fit$update_parameters()`
- `networkSamplingDyads_fit$update_imputation()`
- `networkSamplingDyads_fit$clone()`

**Method new():** constructor for `networkSampling_fit`

*Usage:*

```
networkSamplingDyads_fit$new(partlyObservedNetwork, name)
```

*Arguments:*

- `partlyObservedNetwork` a object with class `partlyObservedNetwork` representing the observed data with possibly missing entries
- `name` a character for the name of sampling to fit on the `partlyObservedNetwork`

**Method show():** show method

*Usage:*

```
networkSamplingDyads_fit$show()
```

**Method update_parameters():** a method to update the estimation of the parameters. By default, nothing to do (corresponds to MAR sampling)

*Usage:*

```
networkSamplingDyads_fit$update_parameters(...)
```

*Arguments:*

... use for compatibility

**Method update_imputation():** a method to update the imputation of the missing entries.

*Usage:*

```
networkSamplingDyads_fit$update_imputation(nu)
```

*Arguments:*

- `nu` the matrix of (uncorrected) imputation for missing entries

**Method clone():** The objects of this class are cloneable with this method.

*Usage:*

```
networkSamplingDyads_fit$clone(deep = FALSE)
```

*Arguments:*

- `deep` Whether to make a deep clone.
networkSamplingNodes_fit

Virtual class used to define a family of networkSamplingNodes_fit

Description

Virtual class used to define a family of networkSamplingNodes_fit

Super class

missSBM::networkSampling -> networkSamplingNodes_fit

Active bindings

penalty double, value of the penalty term in ICL
log_lambda double, term for adjusting the imputation step which depends on the type of sampling

Methods

Public methods:

• networkSamplingNodes_fit$new()
• networkSamplingNodes_fit$show()
• networkSamplingNodes_fit$update_parameters()
• networkSamplingNodes_fit$update_imputation()
• networkSamplingNodes_fit$clone()

Method new(): constructor

Usage:

networkSamplingNodes_fit$new(partlyObservedNetwork, name)

Arguments:

partlyObservedNetwork a object with class partlyObservedNetwork representing the observed data with possibly missing entries
name a character for the name of sampling to fit on the partlyObservedNetwork

Method show(): show method

Usage:

networkSamplingNodes_fit$show()

Method update_parameters(): a method to update the estimation of the parameters. By default, nothing to do (corresponds to MAR sampling)

Usage:

networkSamplingNodes_fit$update_parameters(...)

Arguments:
nodeSampler

... use for compatibility

**Method** update_imputation(): a method to update the imputation of the missing entries.

*Usage:*

networkSamplingNodes_fit$update_imputation(nu)

*Arguments:*

nu the matrix of (uncorrected) imputation for missing entries

**Method** clone(): The objects of this class are cloneable with this method.

*Usage:*

networkSamplingNodes_fit$clone(deep = FALSE)

*Arguments:*

deep Whether to make a deep clone.

---

## nodeSampler

**Virtual class for all node-centered samplers**

### Description

Virtual class for all node-centered samplers

### Super classes

missSBM::networkSampling -> missSBM::networkSampler -> nodeSampler

### Methods

**Public methods:**

- nodeSampler$clone()

**Method** clone(): The objects of this class are cloneable with this method.

*Usage:*

nodeSampler$clone(deep = FALSE)

*Arguments:*

deep Whether to make a deep clone.
nodeSampling_fit  
Class for fitting a node sampling

Description

Class for fitting a node sampling

Super classes

missSBM::networkSampling -> missSBM::networkSamplingNodes_fit -> nodeSampling_fit

Active bindings

vExpec  variational expectation of the sampling

Methods

Public methods:

• nodeSampling_fit$new()
• nodeSampling_fit$clone()

Method new(): constructor

Usage:
nodeSampling_fit$new(partlyObservedNetwork, ...)

Arguments:
partlyObservedNetwork  a object with class partlyObservedNetwork representing the observed
data with possibly missing entries
... used for compatibility

Method clone(): The objects of this class are cloneable with this method.

Usage:
nodeSampling_fit$clone(deep = FALSE)

Arguments:
deep  Whether to make a deep clone.
Observe a network partially according to a given sampling design

**Description**

This function draws observations in an adjacency matrix according to a given network sampling design.

**Usage**

```r
observeNetwork(
  adjacencyMatrix,  
  sampling,  
  parameters,  
  clusters = NULL,  
  covariates = list(),  
  similarity = missSBM::l1_similarity,  
  intercept = 0
)
```

**Arguments**

- `adjacencyMatrix`  
  The N x N adjacency matrix of the network to sample.

- `sampling`  
  The sampling design used to observe the adjacency matrix, see details.

- `parameters`  
  The sampling parameters (adapted to each sampling, see details).

- `clusters`  
  An optional clustering membership vector of the nodes. Only necessary for block samplings.

- `covariates`  
  An optional list with M entries (the M covariates). If the covariates are node-centered, each entry of covariates must be a size-N vector; if the covariates are dyad-centered, each entry of covariates must be N x N matrix.

- `similarity`  
  An optional function to compute similarities between node covariates. Default is `missSBM::l1_similarity`, that is, -abs(x-y). Only relevant when the covariates are node-centered.

- `intercept`  
  An optional intercept term to be added in case of the presence of covariates. Default is 0.

**Details**

Internal functions use `future_lapply`, so set your plan to 'multisession' or 'multicore' to use several cores/workers. The list of parameters control tunes more advanced features, such as the initialization, how covariates are handled in the model, and the variational EM algorithm:

- "useCov": logical. If covariates is not null, should they be used for the for the SBM inference (or just for the sampling)? Default is TRUE.
• "clusterInit": Initial method for clustering: either a character ("spectral") or a list with `length(vBlocks)` vectors, each with size `ncol(adjacencyMatrix)`, providing a user-defined clustering. Default is "spectral".

• "similarity": An R x R -> R function to compute similarities between node covariates. Default is `missSBM:::l1_similarity`, that is, -abs(x-y). Only relevant when the covariates are node-centered (i.e. covariates is a list of size-N vectors).

• "threshold": V-EM algorithm stops when optimization step changes the objective function or the parameters by less than threshold. Default is 1e-2.

• "maxIter": V-EM algorithm stops when the number of iteration exceeds maxIter. Default is 50.

• "fixPointIter": number of fix-point iterations in the V-E step. Default is 3.

• "exploration": character indicating the kind of exploration used among "forward", "backward", "both" or "none". Default is "both".

• "iterates": integer for the number of iterations during exploration. Only relevant when exploration is different from "none". Default is 1.

• "trace": logical for verbosity. Default is TRUE.

The different sampling designs are split into two families in which we find dyad-centered and node-centered samplings. See doi: 10.1080/01621459.2018.1562934 for a complete description.

• Missing at Random (MAR)
  - "dyad": parameter = p = Prob(Dyad(i,j) is observed)
  - "node": parameter = p = Prob(Node i is observed)
  - "covar-dyad": parameter = beta in R^M, such that Prob(Dyad (i,j) is observed) = logistic(parameter' covarArray (i,j, .))
  - "covar-node": parameter = nu in R^M such that Prob(Node i is observed) = logistic(parameter' covarMatrix (i, )
  - "snowball": parameter = number of waves with Prob(Node i is observed in the 1st wave)

• Missing Not At Random (MNAR)
  - "double-standard": parameter = (p0,p1) with p0 = Prob(Dyad (i,j) is observed | the dyad is equal to 0), p1 = Prob(Dyad (i,j) is observed | the dyad is equal to 1)
  - "block-node": parameter = c(p(1),...,p(Q)) and p(q) = Prob(Node i is observed | node i is in cluster q)
  - "block-dyad": parameter = c(p(1,1),...,p(Q,Q)) and p(q,l) = Prob(Edge (i,j) is observed | node i is in cluster q and node j is in cluster l)
  - "degree": parameter = c(a,b) and logit(a+b*degree(i)) = Prob(Node i is observed | Degree(i))

Value

an adjacency matrix with the same dimension as the input, yet with additional NAs.
Examples

```r
## SBM parameters
N <- 300 # number of nodes
Q <- 3 # number of clusters
pi <- rep(1,Q)/Q # block proportion
theta <- list(mean = diag(.45,Q) + .05 ) # connectivity matrix

## simulate an undirected binary SBM without covariate
sbm <- sbm::sampleSimpleSBM(N, pi, theta)

## Sample network data

# some sampling design and their associated parameters
sampling_parameters <- list(
  "dyad" = .3,
  "node" = .3,
  "double-standard" = c(0.4, 0.8),
  "block-node" = c(.3, .8, .5),
  "block-dyad" = theta$mean,
  "degree" = c(.01, .01),
  "snowball" = c(2,.1)
)

observed_networks <- list()

for (sampling in names(sampling_parameters)) {
  observed_networks[[sampling]] <- missSBM::observeNetwork(
    adjacencyMatrix = sbm$networkData,
    sampling = sampling,
    parameters = sampling_parameters[[sampling]],
    cluster = sbm$memberships
  )
}
```

partlyObservedNetwork  
An R6 Class used for internal representation of a partially observed network

Description

An R6 Class used for internal representation of a partially observed network

Details

This class is not exported to the user
Active bindings

- `samplingRate` The percentage of observed dyads
- `nbNodes` The number of nodes
- `nbDyads` The number of dyads
- `is_directed` Logical indicating if the network is directed or not
- `networkData` The adjacency matrix of the network
- `covarArray` The array of covariates
- `covarMatrix` The matrix of covariates
- `samplingMatrix` Matrix of observed and non-observed edges
- `samplingMatrixBar` Matrix of observed and non-observed edges
- `observedNodes` A vector of observed and non-observed nodes (observed means at least one non-NA value)

Methods

Public methods:

- `partlyObservedNetwork$new()`
- `partlyObservedNetwork$clustering()`
- `partlyObservedNetwork$imputation()`
- `partlyObservedNetwork$clone()`

Method `new()`: constructor

Usage:
```
partlyObservedNetwork$new(
  adjacencyMatrix,
  covariates = list(),
  similarity = missSBM:::l1_similarity
)
```

Arguments:

- `adjacencyMatrix` The adjacency matrix of the network
- `covariates` A list with M entries (the M covariates), each of whom being either a size-N vector or N x N matrix.
- `similarity` An R x R -> R function to compute similarities between node covariates. Default is `l1_similarity`, that is, -abs(x-y).

Method `clustering()`: method to cluster network data with missing value

Usage:
```
partlyObservedNetwork$clustering(
  vBlocks,
  imputation = ifelse(is.null(private$phi), "median", "average")
)
```

Arguments:

- `vBlocks` The vector of number of blocks considered in the collection.
imputation character indicating the type of imputation among "median", "average"

**Method** `imputation()`: basic imputation from existing clustering

*Usage:*

```r
partlyObservedNetwork$imputation(type = c("median", "average", "zero"))
```

*Arguments:*

- `type`: a character, the type of imputation. Either "median" or "average"

**Method** `clone()`: The objects of this class are cloneable with this method.

*Usage:*

```r
partlyObservedNetwork$clone(deep = FALSE)
```

*Arguments:*

- `deep`: Whether to make a deep clone.

---

**Description**

Plot function for the various fields of a `missSBM_fit`: the fitted SBM (network or connectivity), and a plot monitoring the optimization.

**Usage**

```r
## S3 method for class 'missSBM_fit'
plot(
  x,
  type = c("imputed", "expected", "meso", "monitoring"),
  dimLabels = list(row = "node", col = "node"),
  ...
)
```

**Arguments**

- `x`: an object with class `missSBM_fit`
- `type`: the type specifies the field to plot, either "imputed", "expected", "meso", or "monitoring"
- `dimLabels`: a list of two characters specifying the labels of the nodes. Default to `list(row = 'node', col = 'node')`
- `...`: additional parameters for S3 compatibility. Not used

**Value**

a `ggplot` object
predicted.missSBM_fit  Prediction of a missSBM_fit (i.e. network with imputed missing dyads)

Description
Prediction of a missSBM_fit (i.e. network with imputed missing dyads)

Usage
## S3 method for class 'missSBM_fit'
predict(object, ...)

Arguments
object  an R6 object with class missSBM_fit
... additional parameters for S3 compatibility.

Value
an adjacency matrix between pairs of nodes. Missing dyads are imputed with their expected values, i.e. by their estimated probabilities of connection under the missing SBM.

SimpleDyadSampler  Class for defining a simple dyad sampler

Description
Class for defining a simple dyad sampler

Super classes
missSBM::networkSampling -> missSBM::networkSampler -> missSBM::dyadSampler -> simpleDyadSampler

Methods
Public methods:
• simpleDyadSampler$new()
• simpleDyadSampler$clone()

Method new(): constructor for networkSampling
Usage:
simpleNodeSampler

simpleDyadSampler$new(
  parameters = NA,
  nbNodes = NA,
  directed = FALSE,
  covarArray = NULL,
  intercept = 0
)

Arguments:
- parameters: the vector of parameters associated to the sampling at play
- nbNodes: number of nodes in the network
- directed: logical, directed network of not
- covarArray: an array of covariates used
- intercept: double, intercept term used to compute the probability of sampling in the presence of covariates. Default 0.

Method clone(): The objects of this class are cloneable with this method.

Usage:
simpleDyadSampler$clone(deep = FALSE)

Arguments:
- deep: Whether to make a deep clone.

simpleNodeSampler Class for defining a simple node sampler

Description
Class for defining a simple node sampler

Super classes
missSBM::networkSampling -> missSBM::networkSampler -> missSBM::nodeSampler -> simpleNodeSampler

Methods

Public methods:
- simpleNodeSampler$new()
- simpleNodeSampler$clone()

Method new(): constructor for networkSampling

Usage:
simpleNodeSampler$new(
  parameters = NA,
  nbNodes = NA,
  directed = FALSE,
  covarMatrix = NULL,
  intercept = 0
)

Arguments:
parameters the vector of parameters associated to the sampling at play
nbNodes number of nodes in the network
directed logical, directed network of not
covarMatrix a matrix of covariates used
intercept double, intercept term used to compute the probability of sampling in the presence of covariates. Default 0.

Method clone(): The objects of this class are cloneable with this method.
Usage:
simpleNodeSampler$clone(deep = FALSE)

Arguments:
deep Whether to make a deep clone.

---
SimpleSBM_fit

This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.

Description
This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.

Details
It is not designed not be call by the user

Super classes

sbm::SBM -> sbm::SimpleSBM -> SimpleSBM_fit

Active bindings
type the type of SBM (distribution of edges values, network type, presence of covariates)
penalty double, value of the penalty term in ICL
entropy double, value of the entropy due to the clustering distribution
loglik double: approximation of the log-likelihood (variational lower bound) reached
ICL double: value of the integrated classification log-likelihood
Methods

Public methods:

• SimpleSBM_fit$new()
• SimpleSBM_fit$doVEM()
• SimpleSBM_fit$reorder()
• SimpleSBM_fit$clone()

Method new(): constructor for simpleSBM_fit for missSBM purpose

Usage:
SimpleSBM_fit$new(networkData, clusterInit, covarList = list())

Arguments:

networkData a structure to store network under missing data condition: either a matrix possibly with NA, or a missSBM::partlyObservedNetwork

clusterInit Initial clustering: a vector with size ncol(adjacencyMatrix), providing a user-defined clustering with nbBlocks levels.

covarList An optional list with M entries (the M covariates).

Method doVEM(): method to perform estimation via variational EM

Usage:
SimpleSBM_fit$doVEM(
  threshold = 0.01,
  maxIter = 100,
  fixPointIter = 3,
  trace = FALSE
)

Arguments:

threshold stop when an optimization step changes the objective function by less than threshold. Default is 1e-4.

maxIter V-EM algorithm stops when the number of iteration exceeds maxIter. Default is 10

fixPointIter number of fix-point iterations in the Variational E step. Default is 5.

trace logical for verbosity. Default is FALSE.

Method reorder(): permute group labels by order of decreasing probability

Usage:
SimpleSBM_fit$reorder()

Method clone(): The objects of this class are cloneable with this method.

Usage:
SimpleSBM_fit$clone(deep = FALSE)

Arguments:

deep Whether to make a deep clone.
**SimpleSBM_fit_MNAR**  
*This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.*

**Description**

This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM. This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.

**Details**

It is not designed not be call by the user

**Super classes**

sbm::SBM -> sbm::SimpleSBM -> missSBM::SimpleSBM_fit -> missSBM::SimpleSBM_fit_noCov  
-> SimpleSBM_MNAR_noCov

**Active bindings**

imputation  the matrix of imputed values  
vExpec  double: variational approximation of the expectation complete log-likelihood

**Methods**

**Public methods:**

- `SimpleSBM_fit_MNAR$new()`  
- `SimpleSBM_fit_MNAR$update_parameters()`  
- `SimpleSBM_fit_MNAR$update_blocks()`  
- `SimpleSBM_fit_MNAR$clone()`

**Method new():** constructor for simpleSBM_fit for missSBM purpose  

*Usage:*
SimpleSBM_fit_MNAR$new(networkData, clusterInit)

*Arguments:*

- `networkData`: a structure to store network under missing data condition: either a matrix possibly with NA, or a missSBM::partlyObservedNetwork  
- `clusterInit`: Initial clustering: a vector with size `ncol(adjacencyMatrix)`, providing a user-defined clustering with `nbBlocks` levels.

**Method update_parameters():** update parameters estimation (M-step)  

*Usage:*
SimpleSBM_fit_MNAR$update_parameters(nu = NULL)

*Arguments:*

SimpleSBM_fit_noCov

nu currently imputed values

**Method** update_blocks(): update variational estimation of blocks (VE-step)

*Usage:*

```r
SimpleSBM_fit_MNAR$update_blocks(log_lambda = 0)
```

*Arguments:*

- `log_lambda` additional term sampling dependent used to de-bias estimation of tau

**Method** clone(): The objects of this class are cloneable with this method.

*Usage:*

```r
SimpleSBM_fit_MNAR$clone(deep = FALSE)
```

*Arguments:*

- `deep` Whether to make a deep clone.

---

SimpleSBM_fit_noCov This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.

---

**Description**

This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.

**Details**

It is not designed not be call by the user

**Super classes**

```
sbm::SBM -> sbm::SimpleSBM -> missSBM::SimpleSBM_fit -> SimpleSBM_fit_noCov
```

**Active bindings**

- `imputation` the matrix of imputed values
- `vExpec` double: variational approximation of the expectation complete log-likelihood
- `vExpec_corrected` double: variational approximation of the expectation complete log-likelihood with correction to be comparable with MNAR criteria
Methods

Public methods:

- SimpleSBM_fit_noCov$update_parameters()
- SimpleSBM_fit_noCov$update_blocks()
- SimpleSBM_fit_noCov$clone()

Method update_parameters(): update parameters estimation (M-step)

Usage:
SimpleSBM_fit_noCov$update_parameters(...)

Arguments:
... additional arguments, only required for MNAR cases

Method update_blocks(): update variational estimation of blocks (VE-step)

Usage:
SimpleSBM_fit_noCov$update_blocks(...)

Arguments:
... additional arguments, only required for MNAR cases

Method clone(): The objects of this class are cloneable with this method.

Usage:
SimpleSBM_fit_noCov$clone(deep = FALSE)

Arguments:
depth Whether to make a deep clone.

SimpleSBM_fit_withCov This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.

Description

This internal class is designed to adjust a binary Stochastic Block Model in the context of missSBM.

Details

It is not designed not be call by the user

Super classes

sbm::SBM -> sbm::SimpleSBM -> missSBM::SimpleSBM_fit -> SimpleSBM_fit_withCov
Active bindings

- imputation: the matrix of imputed values
- vExpec: double: variational approximation of the expectation complete log-likelihood
- vExpec_corrected: double: variational approximation of the expectation complete log-likelihood with correction to be comparable with MNAR criteria

Methods

Public methods:

- SimpleSBM_fit_withCov$update_parameters()
- SimpleSBM_fit_withCov$update_blocks()
- SimpleSBM_fit_withCov$clone()

Method update_parameters(): update parameters estimation (M-step)

Usage:
SimpleSBM_fit_withCov$update_parameters(...)

Arguments:
... use for compatibility
control: a list to tune nlopt for optimization, see documentation of nloptr

Method update_blocks(): update variational estimation of blocks (VE-step)

Usage:
SimpleSBM_fit_withCov$update_blocks(...)

Arguments:
... use for compatibility

Method clone(): The objects of this class are cloneable with this method.

Usage:
SimpleSBM_fit_withCov$clone(deep = FALSE)

Arguments:
deep: Whether to make a deep clone.
Methods

Public methods:

• snowballSampler$new()
• snowballSampler$clone()

Method new(): constructor for networkSampling

Usage:
snowballSampler$new(parameters = NA, adjacencyMatrix = NA, directed = FALSE)

Arguments:
parameters the vector of parameters associated to the sampling at play
adjacencyMatrix the adjacency matrix of the network
directed logical, directed network of not

Method clone(): The objects of this class are cloneable with this method.

Usage:
snowballSampler$clone(deep = FALSE)

Arguments:
deep Whether to make a deep clone.

summary.missSBM_fit  Summary method for a missSBM_fit

Description

Summary method for a missSBM_fit

Usage

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

Arguments

object an R6 object with class missSBM_fit
...
additional parameters for S3 compatibility.

Value

a basic printing output
Description
This dataset contains two networks where the nodes are countries and an edge in network "belligerent" means that the two countries have been at least once at war between years 1816 to 2007 while an edge in network "alliance" means that the two countries have had a formal alliance between years 1816 to 2012. The network belligerent have less nodes since countries which have not been at war are not considered.

Usage
war

Format
A list with 2 two igraph objects, alliance and belligerent. Each graph have three attributes: 'name' (the country name), 'power' (a score related to military power: the higher, the better) and 'trade' (a score related to the trade effort between pairs of countries).

Source
networks were extracted from https://www.correlatesofwar.org/

References

Examples
```r
data(war)
class(war$belligerent)
igraph::gorder(war$alliance)
igraph::gorder(war$belligerent)
igraph::edges(war$alliance)
igraph::get.graph.attribute(war$alliance)
```
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