Package 'gRim'

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Version 0.1-17

Title Graphical Interaction Models

Author Søren Højsgaard <sorenh@math.aau.dk>

Maintainer Søren Højsgaard <sorenh@math.aau.dk>

Description gRaphical Interaction Models:
Models for for contingency tables (i.e. log-linear models)
Graphical Gaussian models for multivariate normal data (i.e. covariance selection models)
Mixed interaction models

License GPL (>= 2)

URL http://people.math.aau.dk/~sorenh/software/gR/

Depends R (>= 2.15.2),methods,gRbase,gRain

Imports igraph

Encoding latin1

Suggests Rgraphviz

ByteCompile yes

LinkingTo Rcpp,RcppArmadillo

NeedsCompilation yes

Repository CRAN

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R topics documented:

`CGstats` *Mean, covariance and counts for grouped data*

Description

`CGstats` provides what corresponds to calling `cow.wt` on different strata of data where the strata are defined by the combinations of factors in data.

Usage

```
CGstats(object, varnames = NULL, homogeneous = TRUE, simplify = TRUE)
## S3 method for class 'data.frame'
CGstats(object, varnames = NULL, homogeneous = TRUE, simplify = TRUE)
```

Arguments

`object`

`varnames`

`homogeneous`

`simplify`

Value

A list whose form depends on the type of input data and the varnames.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

`cov.wt`

Examples

```
data(milkcomp)
```

```
CGstats(milkcomp)
CGstats(milkcomp, c(1,2))
CGstats(milkcomp, c("lactime","treat"))
CGstats(milkcomp, c(3,4))
CGstats(milkcomp, c("fat","protein"))

CGstats(milkcomp, c(2,3,4), simplify=FALSE)
CGstats(milkcomp, c(2,3,4), homogeneous=FALSE)
CGstats(milkcomp, c(2,3,4), simplify=FALSE, homogeneous=FALSE)
```

---

ciTest *Generic function for conditional independence test*

Description

Generic function for conditional independence test. Specializes to specific types of data.

Usage

```
ciTest(x, set=NULL, ...)
## S3 method for class 'data.frame'
ciTest(x, set=NULL, ...)
## S3 method for class 'table'
ciTest(x, set=NULL, ...)
## S3 method for class 'list'
ciTest(x, set=NULL, ...)
```

Arguments

x	An object for which a test for conditional independence is to be made. See 'details' for valid types of x.
set	A specification of the test to be made. The tests are of the form u and v are independent condionally on S where u and v are variables and S is a set of variables. See 'details' for details about specification of set.
...	Additional arguments to be passed on to other methods.

Details

x can be 1) a table, 2) a dataframe whose columns are numerics and factors or 3) a list with components cov and n.obs.

set can be 1) a vector or 2) a right-hand sided formula in which variables are separated by '+'. In either case, it is tested if the first two variables in the set are conditionally independent given the remaining variables in set. (Notice an abuse of the '+' operator in the right-hand sided formula: The order of the variables does matter.)

Value

An object of class 'citest' (which is a list).

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

ciTest.table ciTest_table

ciTest.data.frame ciTest_df

ciTest.list ciTest_mvn

chisq.test

Examples

```
## contingency table:
data(reinis)
## dataframe with only numeric variables:
data(carcass)
## dataframe with numeric variables and factors:
data(milkcomp1)

ciTest(cov.wt(carcass, method='ML'), set=~Fat11+Meat11+Fat12)
ciTest(reinis, set=~smo+phy+sys)
ciTest(milkcomp1, set=~tre+fat+pro)
```

---

ciTest_df *Test for conditional independence in a dataframe*

Description

Test for conditional independence in a dataframe.

Usage

```
ciTest_df(x, set = NULL, ...)
```

Arguments

x	A dataframe.
set	
...	

Details

set can be 1) a vector or 2) a right-hand sided formula in which variables are separated by '+'. In either case, it is tested if the first two variables in the set are conditionally independent given the remaining variables in set. (Notice an abuse of the '+' operator in the right-hand sided formula: The order of the variables does matter.)

If set is NULL then it is tested whether the first two variables are conditionally independent given the remaining variables.

If set consists only of factors then x[,set] is converted to a contingency table and the test is made in this table using ciTest_table().

If set consists only of numeric values and integers then x[,set] is converted to a list with components cov and n.obs by calling cov.wt(x[,set], method='ML'). This list is then passed on to ciTest_mvn() which makes the test.

Value

An object of class 'citest' (which is a list).

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

ciTest

ciTest.table ciTest_table

ciTest.list ciTest_mvn

chisq.test

Examples

```
data(milkcomp1)
ciTest(milkcomp1, set=~tre+fat+pro)
ciTest_df(milkcomp1, set=~tre+fat+pro)
```

`ciTest_mvn` *Test for conditional independence in the multivariate normal distribution*

Description

Test for conditional independence in the multivariate normal distribution.

Usage

```
ciTest_mvn(x, set = NULL, statistic = "DEV", ...)
```

Arguments

`x`	A list with elements `cov` and `n.obs` (such as returned from calling `cov.wt()` on a dataframe. See examples below.)
`set`	
`statistic`	
`...`	

Details

`set` can be 1) a vector or 2) a right-hand sided formula in which variables are separated by '+'. In either case, it is tested if the first two variables in the `set` are conditionally independent given the remaining variables in `set`. (Notice an abuse of the '+' operator in the right-hand sided formula: The order of the variables does matter.)

If `set` is `NULL` then it is tested whether the first two variables are conditionally independent given the remaining variables.

`x` must be a list with components `cov` and `n.obs` such as returned by calling `cov.wt( , method='ML')` on a dataframe.

Value

An object of class 'citest' (which is a list).

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

`ciTest`

`ciTest.table` `ciTest_table`

`ciTest.data.frame` `ciTest_df`

`chisq.test`

Examples

```
data(carcass)
ciTest(cov.wt(carcass, method='ML'), set=~Fat11+Meat11+Fat12)
ciTest_mvn(cov.wt(carcass, method='ML'), set=~Fat11+Meat11+Fat12)
```

`ciTest_ordinal` *A function to compute Monte Carlo and asymptotic tests of conditional independence for ordinal and/or nominal variables.*

Description

The function computes tests of independence of two variables, say u and v, given a set of variables, say S. The deviance, Wilcoxon, Kruskal-Wallis and Jonkheere-Terpstra tests are supported. Asymptotic and Monte Carlo p-values are computed.

Usage

```
ciTest_ordinal(x, set = NULL, statistic = "dev", N = 0, ...)
```

Arguments

`x`	A dataframe or table.
`set`	The variable set (u,v,S), given either as an integer vector of the column numbers of a dataframe or dimension numbers of a table, or as a character vector with the corresponding variable or dimension names.
`statistic`	Either "deviance", "wilcoxon", "kruskal" or "jt".
`N`	The number of Monte Carlo samples. If N<=0 then Monte Carlo p-values are not computed.
`...`	Additional arguments, currently not used

Details

The deviance test is appropriate when u and v are nominal; Wilcoxon, when u is binary and v is ordinal; Kruskal-Wallis, when u is nominal and v is ordinal; Jonckheere-Terpstra, when both u and v are ordinal.

Value

A list including the test statistic, the asymptotic p-value and, when computed, the Monte Carlo p-value.

`P`	Asymptotic p-value
`montecarlo.P`	Monte Carlo p-value

Author(s)

Flaminia Musella, David Edwards, Søren Højsgaard, <sorenh@math.aau.dk>

References

See Edwards D. (2000), "Introduction to Graphical Modelling", 2nd ed., Springer-Verlag, pp. 130-153.

See Also

ciTest_table, ciTest

Examples

```
library(gRim)
data(dumping, package="gRbase")

ciTest_ordinal(dumping, c(2,1,3), stat="jt", N=1000)
ciTest_ordinal(dumping, c("Operation","Symptom","Centre"), stat="jt", N=1000)
ciTest_ordinal(dumping, ~ Operation + Symptom + Centre, stat="jt", N=1000)

data(reinis)
ciTest_ordinal(reinis, c(1,3,4:6),N=1000)

# If data is a dataframe
dd     <- as.data.frame(dumping)
ncells <- prod(dim(dumping))
ff     <- dd$Freq
idx    <- unlist(mapply(function(i,n) rep(i,n),1:ncells,ff))
dumpDF <- dd[idx, 1:3]
rownames(dumpDF) <- 1:NROW(dumpDF)

ciTest_ordinal(dumpDF, c(2,1,3), stat="jt", N=1000)
ciTest_ordinal(dumpDF, c("Operation","Symptom","Centre"), stat="jt", N=1000)
ciTest_ordinal(dumpDF, ~ Operation + Symptom + Centre, stat="jt", N=1000)
```

---

ciTest_table *Test for conditional independence in a contingency table*

Description

Test for conditional independence in a contingency table

Usage

```
ciTest_table(x, set = NULL, statistic = "dev", method = "chisq",
adjust.df = TRUE, slice.info = TRUE, L = 20, B = 200, ...)
```

Arguments

x	A contingency table.
set	
statistic	
method	
adjust.df	
slice.info	
L	
B	
...	Additional arguments.

Details

set can be 1) a vector or 2) a right-hand sided formula in which variables are separated by '+'. In either case, it is tested if the first two variables in the set are conditionally independent given the remaining variables in set. (Notice an abuse of the '+' operator in the right-hand sided formula: The order of the variables does matter.)

If set is NULL then it is tested whether the first two variables are conditionally independent given the remaining variables.

Value

An object of class 'citest' (which is a list).

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

ciTest

ciTest.data.frame ciTest_df

ciTest.list ciTest_mvn

chisq.test

Examples

```
data(reinis)
ciTest(reinis, set=~smo+phy+sys)
ciTest_table(reinis, set=~smo+phy+sys)
```

cmod *Graphical Gaussian model*

Description

Specification of graphical Gaussian model. The 'c' in the name cmod refers to that it is a (graphical) model for 'c'ontinuous variables

Usage

```
cmod(formula, data, marginal = NULL, fit = TRUE, details=0)
```

Arguments

formula	Model specification in one of the following forms: 1) a right-hand sided formula, 2) as a list of generators, 3) an undirected graph (represented either as a graphNEL object or as an adjacency matrix). Notice that there are certain model specification shortcuts, see Section 'details' below
data	Data in one of the following forms: 1) A dataframe or 2) a list with elements cov and n.obs (such as returned by the cov.wt() function.)
marginal	Should only a subset of the variables be used in connection with the model specification shortcuts
fit	Should the model be fitted.
details	Control the amount of output; for debugging purposes.

Details

The independence model can be specified as ~.^1 and the saturated model as ~.^.. The marginal argument can be used for specifying the independence or saturated models for only a subset of the variables.

Value

An object of class cModel (a list)

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

dmod mmod ggmfit

Examples

```
## Graphical Gaussian model
data(carcass)
cm1<-cmod(~.^., carcass)

## Stepwise selection based on BIC
cm2<-backward(cm1,k=log(nrow(carcass)))

## Stepwise selection with fixed edges
cm3<-backward(cm1,k=log(nrow(carcass)),
 fixinMAT=matrix(c("LeanMeat","Meat11","Meat12","Meat13","LeanMeat","Fat11","Fat12","Fat13"),
 ncol=2))
```

---

dmod *Log–linear model*

Description

Specification of log–linear (graphical) model. The 'd' in the name dmod refers to that it is a (graphical) model for 'd'iscrete variables

Usage

```
dmod(formula, data, marginal, interactions=NULL, fit = TRUE, details=0)
```

Arguments

formula	Model specification in one of the following forms: 1) a right-hand sided formula, 2) as a list of generators, 3) an undirected graph (represented either as a graphNEL object or as an adjacency matrix). Notice that there are certain model specification shortcuts, see Section 'details' below.
data	Either a table or a dataframe. In the latter case, the dataframe will be coerced to a table. See 'details' below.
interactions	A number given the highest order interactions in the model, see Section 'details' below.
marginal	Should only a subset of the variables be used in connection with the model specification shortcuts
fit	Should the model be fitted.
details	Control the amount of output; for debugging purposes.

Details

The independence model can be specified as `~.^1` and the saturated model as `~.^.`. Setting e.g. `interactions=3` implies that there will be at most three factor interactions in the model.

Data can be specified as a table of counts or as a dataframe. If data is a dataframe then it will be converted to a table (using `xtabs()`). This means that if the dataframe contains numeric values

then the you can get a very sparse and high dimensional table. When a dataframe contains numeric values it may be worthwhile to discretize data using the `cut()` function.

The `marginal` argument can be used for specifying the independence or saturated models for only a subset of the variables. When `marginal` is given the corresponding marginal table of data is formed and used in the analysis (notice that this is different from the behaviour of `loglin()` which uses the full table.

Value

An object of class `dModel`

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

`cmod` `mmod`

Examples

```
## Graphical log-linear model
data(reinis)
dm1<-dmod(~.^., reinis)
dm2<-backward(dm1, k=2)
dm3<-backward(dm1, k=2, fixin=list(c("family","phys","systol")))
## At most 3-factor interactions
dm1<-dmod(~.^., data=reinis,interactions=3)
```

---

dModel-class *Class* "dModel"

Description

Setting formal classes for dModel, cModel and mModel objects

Objects from the Class

A virtual Class: No objects may be created from it.

Slots

`.S3Class`**:** Object of class `"character"` ~~

Extends

Class `"cModel"`, directly. Class `"mModel"`, by class "cModel", distance 2. Class `"oldClass"`, by class "cModel", distance 3.

Methods

No methods defined with class "dModel" in the signature.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

Examples

```
showClass("dModel")
```

---

effloglin *Fitting Log-Linear Models by Message Passing*

Description

Fit log-linear models to multidimensional contingency tables by Iterative Proportional Fitting.

Usage

```
effloglin(table, margin, fit = FALSE, eps = 0.01, iter=20, print = TRUE)
```

Arguments

table	A contingency table
margin	A generating class for a hierarchical log–linear model
fit	If TRUE, the fitted values are returned.
eps	Convergence limit; see 'details' below.
iter	Maximum number of iterations allowed
print	If TRUE, iteration details are printed.

Details

The function differs from loglin in that 1) data can be given in the form of a list of sufficient marginals and 2) the model is fitted only on the cliques of the triangulated interaction graph of the model. This means that the full table is not fitted, which means that effloglin is efficient (in terms of storage requirements). However effloglin is implemented entirely in R and is therefore slower than loglin.

Value

A list with compnents

comp1	Description of 'comp1'
comp2	Description of 'comp2'

...

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

loglin

Examples

```
data(reinis)
glist <-list(c("smoke", "mental"), c("mental", "phys"), c("phys", "systol"
), c("systol", "smoke"))

stab <- lapply(glist, function(gg) tableMargin(reinis, gg))
fv3 <- effloglin(stab, glist, print=FALSE)
```

---

getEdges *Find edges in a graph and edges not in an undirected graph.*

Description

Returns the edges of a graph (or edges not in a graph) where the graph can be either a graphNEL object, a list of generators or an adjacency matrix.

Usage

```
getEdges(object, type = "unrestricted", ingraph=TRUE, discrete=NULL, ...)
## S3 method for class 'list'
getEdges(object, type = "unrestricted", ingraph=TRUE, discrete=NULL, ...)
## S3 method for class 'graphNEL'
getEdges(object, type = "unrestricted", ingraph=TRUE, discrete=NULL, ...)
## S3 method for class 'matrix'
getEdges(object, type = "unrestricted", ingraph=TRUE, discrete=NULL, ...)

getInEdges(object, type = "unrestricted", discrete=NULL, ...)
getOutEdges(object, type = "unrestricted", discrete=NULL, ...)
getInEdgesMAT(adjmat, type = "unrestricted", discrete=NULL, ...)
getOutEdgesMAT(adjmat, type = "unrestricted", discrete=NULL, ...)
```

Arguments

object	An object representing a graph; either a generator list, a graphNEL object or an adjacency matrix.
type	Either "unrestricted" or "decomposable"

ingraph	If TRUE the result is the edges in the graph; if FALSE the result is the edges not in the graph.
discrete	This argument is relevant only if object specifies a marked graph in which some vertices represent discrete variables and some represent continuous variables.
...	Additional arguments; currently not used.
adjmat	An adjacency matrix

Details

When ingraph=TRUE: If type="decomposable" then getEdges() returns those edges e for which the graph with e removed is decomposable.

When ingraph=FALSE: Likewise, if type="decomposable" then getEdges() returns those edges e for which the graph with e added is decomposable.

The functions getInEdges() and getInEdges() are just wrappers for calls to getEdges().

The workhorses are getInEdgesMAT() and getOutEdgesMAT() and these work on adjacency matrices.

Regarding the argument discrete, please see the documentation of mcsmarked.

Value

A p * 2 matrix with edges.

Note

These functions work on undirected graphs. The behaviour is undocumented for directed graphs.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

edgeList, nonEdgeList mcsmarked

Examples

```
gg     <- ug(~a:b:d+a:c:d+c:e)
glist  <- getCliques(gg)
adjmat <- as.adjMAT(gg)

#### On a glist
getEdges(glist)
getEdges(glist,type="decomposable")
# Deleting (a,d) would create a 4-cycle

getEdges(glist, ingraph=FALSE)
getEdges(glist,type="decomposable", ingraph=FALSE)
# Adding (e,b) would create a 4-cycle
```

```
#### On a graphNEL
getEdges(gg)
getEdges(gg,type="decomposable")
# Deleting (a,d) would create a 4-cycle

getEdges(gg, ingraph=FALSE)
getEdges(gg,type="decomposable", ingraph=FALSE)
# Adding (e,b) would create a 4-cycle

#### On an adjacency matrix
getEdges(adjmat)
getEdges(adjmat,type="decomposable")
# Deleting (a,d) would create a 4-cycle

getEdges(adjmat, ingraph=FALSE)
getEdges(adjmat,type="decomposable", ingraph=FALSE)
# Adding (e,b) would create a 4-cycle


## Marked graphs; vertices a,b are discrete; c,d are continuous
UG <- ug(~a:b:c+b:c:d)
disc <- c("a","b")
getEdges(UG)
getEdges(UG, discrete=disc)
## Above: same results; there are 5 edges in the graph

getEdges(UG, type="decomposable")
## Above: 4 edges can be removed and will give a decomposable graph
##(only removing the edge (b,c) would give a non-decomposable model)

getEdges(UG, type="decomposable", discrete=c("a","b"))
## Above: 3 edges can be removed and will give a strongly decomposable
## graph. Removing (b,c) would create a 4--cycle and removing (a,b)
## would create a forbidden path; a path with only continuous vertices
## between two discrete vertices.
```

---

ggmfit *Iterative proportional fitting of graphical Gaussian model*

Description

Fit graphical Gaussian model by iterative proportional fitting.

Usage

```
ggmfit( S, n.obs, glist, start=NULL, eps=1e-12, iter=1000, details=0, ...)
ggmfitr(S, n.obs, glist, start=NULL, eps=1e-12, iter=1000, details=0, ...)
```

Arguments

S	Empirical covariance matrix
n.obs	Number of observations
glist	Generating class for model (a list)
start	Initial value for concentration matrix
eps	Convergence criterion
iter	Maximum number of iterations
details	Controlling the amount of output.
...	Optional arguments; currently not used

Details

ggmfit is based on a C implementation. ggmfitr is implemented purely in R (and is provided mainly as a benchmark for the C-version).

Value

A list with

lrt	Likelihood ratio statistic (-2logL)
df	Degrees of freedom
logL	log likelihood
K	Estimated concentration matrix (inverse covariance matrix)

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

cmod, loglin

Examples

```
## Fitting "butterfly model" to mathmark data
## Notice that the output from the two fitting functions is not
## entirely identical.
data(math)
ddd <- cov.wt(math, method="ML")
glist <- list(c("al","st","an"), c("me","ve","al"))
ggmfit (ddd$cov, ddd$n.obs, glist)
ggmfitr(ddd$cov, ddd$n.obs, glist)
```

ghk2phkParms — *Conversion between different parametrizations of mixed interaction models.*

Description

Functions to convert between canonical parametrization (g,h,K), moment parametrization (p,m,S) and mixed parametrization (p,h,K).

Usage

```
ghk2phkParms(parms)
ghk2pmsParms(parms)
phk2ghkParms(parms)
phk2pmsParms(parms)
pms2ghkParms(parms)
pms2phkParms(parms)
```

Arguments

parms	Parameters of a mixed interaction model

Value

Parameters of a mixed interaction model.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

loglinDim — *Return the dimension of a log-linear model*

Description

Return the dimension of a log-linear model given by the generating class 'glist'. If the model is decomposable and adjusted dimension can be found.

Usage

```
loglinGenDim(glist, tableinfo)
loglinDecDim(glist, tableinfo, adjust=TRUE)
```

Arguments

glist	Generating class (a list) for a log-linear model. See 'details' below.
tableinfo	Specification of the levels of the variables. See 'details' below.
adjust	Should model dimension be adjusted for sparsity of data (only available for decomposable models)

Details

glist can be either a list of vectors with variable names or a list of vectors of variable indices.

tableinfo can be one of three different things.

1) A contingency table (a table).

2) A list with the names of the variables and their levels (such as one would get if calling dimnames on a table).

3) A vector with the levels. If glist is a list of vectors with variable names, then the entries of the vector tableinfo must be named.

If the model is decomposable it loglinDecDim is to be preferred over loglinGenDim as the former is much faster.

Setting adjust=TRUE will force loglinDecDim to calculated a dimension which is adjusted for sparsity of data. For this to work, tableinfo *MUST* be a table.

Value

A numeric.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

dmod, glm, loglm

Examples

```
## glist contains variable names and tableinfo is a named vector:
loglinGenDim(list(c("a","b"),c("b","c")), c(a=4,b=7,c=6))

## glist contains variable names and tableinfo is not named:
loglinGenDim(list(c(1,2),c(2,3)), c(4,7,6))

## For decomposable models:
loglinDecDim(list(c("a","b"),c("b","c")), c(a=4,b=7,c=6),adjust=FALSE)
```

mmod *Mixed interaction model.*

Description

A mixed interaction model is a model (often with conditional independence restrictions) for a combination of discrete and continuous variables.

Usage

```
mmod(formula, data, marginal = NULL, fit = TRUE, details = 0)
```

Arguments

formula

data

marginal

fit

details

Value

An object of class `mModel` and the more general class `iModel`.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

dmod cmod

Examples

```
### FIXME: To be written
```

`modify_glist` *Modify generating class for a graphical/hierarchical model*

Description

Modify generating class for a graphical/hierarchical model by 1) adding edges, 2) deleting edges, 3) adding terms and 4) deleting terms.

Usage

```
modify_glist(glist, items, details = 0)
```

Arguments

`glist`	A list of vectors where each vector is a generator of the model.
`items`	A list with edges / terms to be added and deleted. See section 'details' below.
`details`	Control the amount of output (for debugging purposes).

Details

The `items` is a list with named entries as `list(add.edge=, drop.edge=, add.term=, drop.term=)`

Not all entries need to be in the list. The corresponding actions are carried out in the order in which they appear in the list.

See section 'examples' below for examples.

Notice that the operations do not in general commute: Adding an edge which is already in a generating class and then removing the edge again does not give the original generating class.

Value

A generating class for the modified model. The elements of the list are character vectors.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

`cmod` `dmod` `mmod`

Examples

```
glist <- list(c(1,2,3),c(2,3,4))

## Add edges
modify_glist(glist, items=list(add.edge=c(1,4)))
modify_glist(glist, items=list(add.edge=~1:4))
```

```
## Add terms
modify_glist(glist, items=list(add.term=c(1,4)))
modify_glist(glist, items=list(add.term=~1:4))

## Notice: Only the first term is added as the second is already
## in the model.
modify_glist(glist, items=list(add.term=list(c(1,4),c(1,3))))
modify_glist(glist, items=list(add.term=~1:4+1:3))

## Notice: Operations are carried out in the order given in the
## items list and hence we get different results:
modify_glist(glist, items=list(drop.edge=c(1,4), add.edge=c(1,4)))
modify_glist(glist, items=list(add.edge=c(1,4), drop.edge=c(1,4)))
```

`stepwise.iModel; backward; forward`
Stepwise model selection in (graphical) interaction models

Description

Stepwise model selection in (graphical) interaction models

Usage

```
## S3 method for class 'iModel'
stepwise(object,
 criterion = "aic", alpha = NULL, type ="decomposable",
 search="all", steps = 1000, k = 2,
 direction = "backward", fixinMAT=NULL, fixoutMAT=NULL,
 details = 0, trace = 2, ...)

backward(object,
 criterion = "aic", alpha = NULL, type = "decomposable",
 search="all", steps = 1000, k = 2,
 fixinMAT=NULL, details = 1, trace = 2,...)

forward(object,
 criterion = "aic", alpha = NULL, type = "decomposable",
 search="all", steps = 1000, k = 2,
 fixoutMAT=NULL,  details = 1, trace = 2,...)
```

Arguments

`object`	An `iModel` model object
`criterion`	Either `"aic"` or `"test"` (for significance test)
`alpha`	Critical value for deeming an edge to be significant/ insignificant. When `criterion="aic"`, `alpha` defaults to 0; when `criterion="test"`, `alpha` defaults to 0.05.

type	Type of models to search. Either "decomposable" or "unrestricted". If type="decomposable" and the initial model is decompsable, then the search is among decomposable models only.
search	Either 'all' (greedy) or 'headlong' (search edges randomly; stop when an improvement has been found).
steps	Maximum number of steps.
k	Penalty term when criterion="aic". Only k=2 gives genuine AIC.
fixinMAT	Matrix (p x 2) of edges. If those edges are in the model, they are not considered for removal.
fixoutMAT	Matrix (p x 2) of edges. If those edges are not in the model, they are not considered for addition.
direction	Direction for model search. Either "backward" or "forward".
details	Controls the level of printing on the screen.
trace	For debugging only.
...	Further arguments to be passed on to testdelete (for testInEdges) and testadd (for testOutEdges).

Value

An iModel model object.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

cmod dmod mmod testInEdges testOutEdges

Examples

```
data(reinis)
## The saturated model
m1 <- dmod(~.^., data=reinis)
m2 <- stepwise(m1)
m2
```

testadd *Test addition of edge to graphical model*

Description

Performs a test of addition of an edge to a graphical model (an `iModel` object).

Usage

```
testadd(object, edge, k=2, details=1, ...)
```

Arguments

`object`	A model; an object of class `iModel`.
`edge`	An edge; either as a vector or as a right hand sided formula.
`k`	Penalty parameter used when calculating change in AIC
`details`	The amount of details to be printed; 0 surpresses all information
`...`	Further arguments to be passed on to the underlying functions for testing; that is to CItable and CImvn

Details

Let M0 be the model and e={u,v} be an edge and let M1 be the model obtained by adding e to M0. If M1 is decomposable AND e is contained in one clique C only of M1 then the test is carried out in the C-marginal model. In this case, and if the model is a log-linear model then the degrees of freedom is adjusted for sparsity.

Value

A list

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

testdelete

Examples

```
## ## ## testadd
## ## ##

## ## Discrete model
## ##
data(reinis)
```

```
## A decomposable model
##
mf <- ~smoke:phys:mental+smoke:systol:mental
object <- dmod(mf, data=reinis)
testadd(object,c("systol","phys"))


## A non-decomposable model
##
mf <- ~smoke:phys+phys:mental+smoke:systol+systol:mental
object <- dmod(mf, data=reinis)
testadd(object,c("phys","systol"))


## ## Continuous model
## ##
data(math)
## A decomposable model
##
mf <- ~me:ve:al+al:an
object <- cmod(mf, data=math)
testadd(object,c("me","an"))

## A non-decomposable model
##
mf <- ~me:ve+ve:al+al:an+an:me
object <- cmod(mf, data=math)
testadd(object,c("me","al"))
```

`testdelete` *Test deletion of edge from an interaction model*

Description

Tests if an edge can be deleted from an interaction model.

Usage

```
testdelete(object, edge, k=2, details=1,...)
```

Arguments

`object`	A model; an object of class `iModel`.
`edge`	An edge in the model; either as a right-hand sided formula or as a vector
`k`	Penalty parameter used when calculating change in AIC
`details`	The amount of details to be printed; 0 surpresses all information
`...`	Further arguments to be passed on to the underlying functions for testing; that is to CItable and CImvn

Details

If the model is decomposable and the edge is contained in one clique only then the test is made in the marginal model given by that clique. In that case, if the model is a log-linear model then degrees of freedom are adjusted for sparsity

Value

A list.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

testadd

Examples

```
## ## ## testdelete
## ## ##

## ## Discrete model
## ##
data(reinis)
## A decomposable model
##
mf <- ~smoke:phys:mental+smoke:systol:mental
object <- dmod(mf, data=reinis)

testdelete(object,c("phys","mental"))
testdelete(object,c("smoke","mental"))
#testdelete(object,c("systol","phys"))


## A non-decomposable model
##
mf <- ~smoke:phys+phys:mental+smoke:systol+systol:mental
object <- dmod(mf, data=reinis)

testdelete(object,c("phys","mental"))
#testdelete(object,c("systol","phys"))
#testdelete(object,c("smoke","mental"))


## ## Continuous model
## ##
data(math)
## A decomposable model
##
mf <- ~me:ve:al+me:al:an
object <- cmod(mf, data=math)
```

```
testdelete(object,c("ve","al"))
testdelete(object,c("me","al"))
```

`testInEdges; testOutEdges`

Test edges in graphical models with p-value/AIC value

Description

Test edges in graphical models with p-value/AIC value. The models must `iModels`.

Usage

```
testInEdges (object, edgeMAT=NULL, criterion = "aic", k = 2,
 alpha = NULL, headlong = FALSE, details = 1, ...)
testOutEdges(object, edgeMAT=NULL, criterion = "aic", k = 2,
 alpha = NULL, headlong = FALSE, details = 1, ...)
```

Arguments

`object`	An `iModel` model object
`edgeMAT`	A p * 2 matrix with edges
`criterion`	Either `"aic"` or `"test"` (for significance test)
`k`	Penalty term when `criterion="aic"`. Only k=2 gives genuine AIC.
`alpha`	Critical value for deeming an edge to be significant/ insignificant. When `criterion="aic"`, `alpha` defaults to 0; when `criterion="test"`, `alpha` defaults to 0.05.
`headlong`	If TRUE then testing will stop once a model improvement has been found.
`details`	Controls the level of printing on the screen.
`...`	Further arguments to be passed on to `testdelete` (for `testInEdges`) and `testadd` (for `testOutEdges`).

Value

A matrix.

Author(s)

Søren Højsgaard, <sorenh@math.aau.dk>

See Also

`getEdges`, `testadd`, `testdelete`

Examples

```
data(math)
cm1 <- cmod(~me:ve+ve:al+al:an, data=math)
testInEdges(cm1, getEdges(cm1$glist))
testOutEdges(cm1, getEdges(cm1$glist, ingraph=FALSE))
```

Index