Package 'irtrees'

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Title Estimation of Tree-Based Item Response Models

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Description Helper functions and example data sets to facilitate the estimation of IRTree models from data with different shape and using different software.

Depends R(>= 4.0)

Imports DiagrammeR, tidyr

License GPL (>= 2)

LazyLoad yes

LazyData yes

Suggests lme4, mirt, knitr, flextable, reshape2

VignetteBuilder knitr

RoxygenNote 7.1.2

NeedsCompilation no

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R topics documented:

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irtrees-package   *Estimation of Tree-Based Item Response Models*

Description

Helper functions and example data sets to facilitate the estimation of tree-based item Response models of the GLMM family with function `glmer` from the `lme4` package

Author(s)

Ivailo Partchev <partchev@gmail.com>

References

De Boeck, P. and Partchev, I. (2012). IRTrees: Tree-Based Item Response Models of the GLMM Family, *Journal of Statistical Software – Code Snippets*, **48**(1), 1–28. https://www.jstatsoft.org/v48/c01/.

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dendrify   *Measurement Mapping for an IRTree Model*

Description

Expands a wide-form matrix of item responses to a long-form data frame of sub-item responses

Usage

```
dendrify(mat, cmx)
```

Arguments

mat	An integer matrix of IRT responses (columns represent items, rows represent respondents)
cmx	A mapping matrix with as many rows as there are response options for the items.

Value

A data frame with one row per sub-item response

Author(s)

Ivailo Partchev

References

De Boeck, P. and Partchev, I. (2012). IRTrees: Tree-Based Item Response Models of the GLMM Family, *Journal of Statistical Software – Code Snippets*, **48**(1), 1–28. https://www.jstatsoft.org/v48/c01/.

See Also

exogenize

Examples

```
mapping <- cbind(c(0,1,1), c(NA,0,1))
str(linrespT <- dendrify(linresp, mapping))
```

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exogenize	*Structural Mapping for an IRTree Model*

Description

Expands a wide-form file of item responses to a long-form file supporting structural mappings among latent variables

Usage

```
exogenize(mat, cmx, items=seq_len(ncol(mat)), endnode, crossitem=NULL)
```

Arguments

mat	An integer matrix of IRT responses (columns represent items, rows represent respondents)
cmx	The mapping matrix.
items	A numeric vector with the column positions of all items (measurement variables) in mat. Defaults to all columns of mat.
endnode	A factor with the same length as items indicating the latent variable to which the item is attached, and compatible with the mapping matrix.
crossitem	A factor with the same length as items indicating the original items that have been crossed with endnode (e.g., given at various occasions over time), thus producing the actual items. This is not meaningful when the design is nested, and should better be omitted in such cases.

Value

A data frame with columns:

person   a factor identifying the respondent;

item   a factor identifying the items;

exo1 to exoS   dummy variables identifying the internal nodes: these play the same role as
                `exofactor` but are necessary when the model must include independent random
                effects;

endnode   a factor identifying the end nodes and thus the endogeneous latent variables;

crossitem   a factor produced only for crossed designs, identifying the items that are crossed
                with endnode, for example, in the case when the same items are repeated over
                time in a longitudinal design;

value   the binary item responses.

Author(s)

Ivailo Partchev

References

De Boeck, P. and Partchev, I. (2012). IRTrees: Tree-Based Item Response Models of the GLMM
Family, *Journal of Statistical Software – Code Snippets*, **48**(1), 1–28. https://www.jstatsoft.
org/v48/c01/.

See Also

dendrify

Examples

```
str(linlatT <- exogenize(linlat,
   cbind(c(1,0,0), c(1,1,0), c(0,1,0), c(0,1,1), c(0,0,1)),
   endnode = rep(1:3, each=10), cross = rep(1:10, 3)))
```

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  graph2mx   *Convert a tree to a mapping matrix*

Description

Convert a tree description in mermaid format into a mapping matrix that can be used with the
remaining functions in the package.

Usage

```
graph2mx(td)
```

Arguments

td	tree description in mermaid format

Value

the mapping matrix

---

linlat	*Example Data: Sequential-Order Latent Variable Models*

Description

Simulated example data set for a model with sequential-order latent variable models.

Format

An IRT response matrix with 300 persons and 30 binary items.

References

De Boeck, P. and Partchev, I. (2012). IRTrees: Tree-Based Item Response Models of the GLMM Family, *Journal of Statistical Software – Code Snippets*, **48**(1), 1–28. https://www.jstatsoft.org/v48/c01/.

Examples

```
str(linlat)
str(linlatT <- exogenize(linlat,
cbind(c(1,0,0), c(1,1,0), c(0,1,0), c(0,1,1), c(0,0,1)),
    endnode = rep(1:3, each=10), cross = rep(1:10, 3)))
```

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linresp	*Example Data: Linear Hierarchical Categories*

Description

Simulated example data set with linear hierarchical categories.

Format

An IRT response matrix with 300 persons and 10 three-category items.

References

De Boeck, P. and Partchev, I. (2012). IRTrees: Tree-Based Item Response Models of the GLMM Family, *Journal of Statistical Software – Code Snippets*, **48**(1), 1–28. https://www.jstatsoft.org/v48/c01/.

Examples

```
str(linresp)
mapping <- cbind(c(0,1,1), c(NA,0,1))
str(linrespT <- dendrify(linresp, mapping))
```

LtoL_multi.tree *Long-to-long, multiple trees*

Description

Recode a long format data frame to a long format IRTRees data frame in the case when items may
have different tree structures

Usage

```
LtoL_multi.tree(
  data,
  cmx_list,
  item_list,
  id.col,
  item.col,
  resp.col,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

data	a long-format (person-item-response) data set
cmx_list	a list including all tree structures
item_list	a list of vectors, with a length matching the length of cmx_list; each element of such a vector points to an item ID in item.col using the corresponding mapping matrix
id.col	the person ID column
item.col	the item ID column
resp.col	the response column
covar.col	columns containing covariates
time.col	the time column. If not NULL, time.col should be nested in id.col, since it indicates repeated measures within persons

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

LtoL_single.tree   *Long-to-long, single tree*

Description

Recode a long format data frame to a long format IRTrees data frame in the case when items have the same tree structure

Usage

```
LtoL_single.tree(
  data,
  cmx,
  id.col,
  item.col,
  resp.col,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

data	a long-format (person-item-response) data set
cmx	a a category-by-node mapping matrix
id.col	the person ID column
item.col	the item ID column
resp.col	the response column
covar.col	columns containing covariates
time.col	the time column. If not NULL, time.col should be nested in id.col, since it indicates repeated measures within persons

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

| LtoW_multi.tree | *Long-to-wide, multiple trees* |

Description

Recode a long format data frame to a wide format IRTRees data frame in the case when items may have different tree structures

Usage

```
LtoW_multi.tree(
  data,
  cmx_list,
  item_list,
  id.col,
  item.col,
  resp.col,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

data	a long-format (person-item-response) data set
cmx_list	a list including all tree structures
item_list	a list of vectors, with a length matching the length of cmx_list; each element of such a vector points to an item ID in item.col using the corresponding mapping matrix
id.col	the person ID column
item.col	the item ID column
resp.col	the response column
covar.col	columns containing covariates
time.col	the time column. If not NULL, time.col should be nested in id.col, since it indicates repeated measures within persons

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

LtoW_single.tree *Long-to-wide, single tree*

Description

Recode a long format data frame to a wide format IRTrees data frame in the case when items have the same tree structure

Usage

```
LtoW_single.tree(
  data,
  cmx,
  id.col,
  item.col,
  resp.col,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

data	a long-format (person-item-response) data set
cmx	a a category-by-node mapping matrix
id.col	the person ID column
item.col	the item ID column
resp.col	the response column
covar.col	columns containing covariates
time.col	the time column. If not NULL, time.col should be nested in id.col, since it indicates repeated measures within persons

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

---

neslat   *Example Data: Nested Hierarchical Categories*

Description

Simulated example data set for a model with nested hierarchical latent variables.

Format

An IRT response matrix with 300 persons and 30 binary items.

References

De Boeck, P. and Partchev, I. (2012). IRTrees: Tree-Based Item Response Models of the GLMM Family, *Journal of Statistical Software – Code Snippets*, **48**(1), 1–28. https://www.jstatsoft.org/v48/c01/.

Examples

```
str(neslat)
str(neslatT <-
    exogenize(neslat, cbind(c(1,1,1), c(1,0,0), c(0,1,0), c(0,0,1)),
endnode=rep(1:3, each = 10)))
```

---

nesresp   *Example Data: Nested Hierarchical Latent Variables*

Description

Simulated example data set with nested hierarchical categories.

Usage

```
data(nesresp)
```

Format

An IRT response matrix with 300 persons and 10 four-category items.

References

De Boeck, P. and Partchev, I. (2012). IRTrees: Tree-Based Item Response Models of the GLMM Family, *Journal of Statistical Software – Code Snippets*, **48**(1), 1–28. https://www.jstatsoft.org/v48/c01/.

Examples

```
str(nesresp)
head(nesresp)
str(nesrespT <-
    dendrify(nesresp, cbind(c(0,0,1,1), c(0,1,NA,NA), c(NA,NA,0,1))))
head(nesrespT, 20)
```

---

tolong	*Convert a wide-format matrix to long format*

Description

Convert an IRT response matrix in the wide format to a data frame in the long format. In the wide format each row corresponds to a respondent and each column to an item.

Usage

```
tolong(mat)
```

Arguments

mat   an integer IRT response matrix (i.e. a wide format)

Value

a long-format data frame

VerbAgg2	*Verbal Aggression Data, Dichotomized Items*

Description

Item responses to a questionaire on verbal aggression. These data are used throughout De Boeck and Wilson, Explanatory Item Response Models (Springer, 2004) to illustrate various forms of item response models.

Format

A data matrix with 316 persons, 24 three-category items, and two person covariates (trait anger and gender).

Source

http://bear.soe.berkeley.edu/EIRM/

References

De Boeck and Wilson (2004), Explanatory Item Response Models, Springer.

Examples

```
str(VerbAgg2)
mapping <- cbind(c(1,1,1), diag(3))
str(VerbAgg2T <- exogenize(VerbAgg2[,-c(1,2)], mapping,
endnode=rep(1:3, 8)))
```

VerbAgg3   *Verbal Aggression Data, Three-Category Items*

Description

Item responses to a questionaire on verbal aggression. These data are used throughout De Boeck and Wilson, Explanatory Item Response Models (Springer, 2004) to illustrate various forms of item response models.

Format

A data matrix with 316 persons, 24 three-category items, and two person covariates (trait anger and gender).

Source

http://bear.soe.berkeley.edu/EIRM/

References

De Boeck and Wilson (2004), Explanatory Item Response Models, Springer.

Examples

```
str(VerbAgg3)
mapping <- cbind(c(0,1,1), c(NA,0,1))
str(VerbAgg3T <- dendrify(VerbAgg3[,-c(1,2)], mapping))
```

WtoL_multi.tree   *Wide-to-long, multiple trees*

Description

Recode a wide format data frame to a long format IRTRees data frame in the case when items may have different tree structures

Usage

```
WtoL_multi.tree(
  data,
  cmx_list,
  id.col,
  resp.col_list,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

data	a wide-format (person-by-item) data set
cmx_list	a list including all tree structures
id.col	the ID column
resp.col_list	a list of vectors, with a length matching the length of `cmx_list`; each element of such a vector points to an item (response variable) using the corresponding mapping matrix
covar.col	columns containing covariates
time.col	the time column when there are repeated (longitudinal) data

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

WtoL_single.tree *Wide-to-long, one tree*

Description

Recode a wide format data frame to a long format IRTrees data frame in the case when all items have the same tree structure

Usage

```
WtoL_single.tree(
  data,
  cmx,
  id.col,
  resp.col,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

data	a wide-format (person-by-item) data set
cmx	a a category-by-node mapping matrix
id.col	the ID column
resp.col	the columns containing the item responses
covar.col	columns containing covariates
time.col	the time column when there are repeated (longitudinal) data

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

WtoW_multi.tree *Wide-to-wide, multiple trees*

Description

Recode a wide format data frame to a wide format IRTRees data frame in the case when items may have different tree structures

Usage

```
WtoW_multi.tree(
  data,
  cmx_list,
  id.col = NULL,
  resp.col_list,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

`data`	a wide-format (person-by-item) data set
`cmx_list`	a list including all tree structures
`id.col`	the ID column
`resp.col_list`	a list of vectors, with a length matching the length of `cmx_list`; each element of such a vector points to an item (response variable) using the corresponding mapping matrix
`covar.col`	columns containing covariates
`time.col`	the time column when there are repeated (longitudinal) data

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

   `WtoW_single.tree`   *Wide-to-wide, one tree*

Description

Recode a wide format data frame to a wide format IRTrees data frame in the case when all items have the same tree structure

Usage

```
WtoW_single.tree(
  data,
  cmx,
  id.col = NULL,
  resp.col = NULL,
  covar.col = NULL,
  time.col = NULL
)
```

Arguments

`data`	a wide-format (person-by-item) data set
`cmx`	a a category-by-node mapping matrix
`id.col`	the ID column
`resp.col`	the columns containing the item responses
`covar.col`	columns containing covariates
`time.col`	the time column when there are repeated (longitudinal) data

Details

Many examples of mapping matrices are given in the vignette. Columns may be specified by numeric index or by name. Response categories must be coded with consecutive integers starting from 1, not 0. Missing data should be properly represented as NA.

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