Package 'lordif'

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Title Logistic Regression Differential Item Functioning using IRT

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Description Analysis of Differential Item Functioning (DIF) for dichotomous and polytomous items using an iterative hybrid of (ordinal) logistic regression and item response theory (IRT)

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`lordif-package` *LOgistic Regression Differential Item Functioning using IRT*

Description

Analysis of Differential Item Functioning (DIF) for dichotomous and polytomous items using an iterative hybrid of (ordinal) logistic regression and item response theory (IRT).

Details

Package:	lordif
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Version:	0.2-1
Date:	2011-11-16
License:	GPL (>=2)
LazyLoad:	yes

Ordinal logistic regression (OLR) provides a flexible framework for detecting various types of DIF. Previous efforts extended the framework by substituting the matching variable based on sum scores with IRT based trait scores and by employing an iterative process of purifying the matching variable with the use of group-specific item parameters (Crane et. al., 2006). This package represents an effort to integrate both statistical and IRT procedures into a single program. A Monte Carlo simulation approach was incorporated to derive empirical threshold values for various DIF statistics and effect size measures. The two most important functions are: `lordif` and `montecarlo`.

Author(s)

Seung W. Choi, with contributions from Laura E. Gibbons and Paul K. Crane Maintainer: Seung W. Choi <s-choi@northwestern.edu>

References

Choi, S. W., Gibbons, L. E., Crane, P. K. (2011). lordif: An R Package for Detecting Differential Item Functioning Using Iterative Hybrid Ordinal Logistic Regression/Item Response Theory and Monte Carlo Simulations. Journal of Statistical Software, 39(8), 1-30. URL http://www.jstatsoft.org/v39/i08/.

Crane, P. K., Gibbons, L. E., Jolley, L., & van Belle, G. (2006). Differential item functioning analysis with ordinal logistic regression techniques: DIF detect and difwithpar. Medical Care, 44(11 Suppl 3), S115-S123.

See Also

ltm, rms

Examples

```
##load PROMIS Anxiety sample data (n=766)
  ## Not run: data(Anxiety)
##age : 0=younger than 65 or 1=65 or older
##gender: 0=Male or 1=Female
##education: 0=some college or higher 1=high school or lower
##run age-related DIF on all 29 items (takes about a minute)
  ## Not run: age.dif <- lordif(Anxiety[paste("R",1:29,sep="")],Anxiety$age)
##print output
  ## Not run: print(age.dif)
##print extended output
  ## Not run: summary(age.dif)
##generate plots for DIF items (reference group: <65)
  ## Not run: plot(age.dif,labels=c("Younger","Older"))
##run Monte Carlo simulations for threshold values
##this may take several minutes
  ## Not run: age.dif.MC<-montecarlo(age.dif,alpha=0.05,nr=100)
##print output
  ## Not run: print(age.dif.MC)
##print extended output
  ## Not run: summary(age.dif.MC)
##generate plots for Monte Carlo threshold values
  ## Not run: plot(age.dif.MC)
```

Anxiety *A Measure of Anxiety*

Description

The data contain responses given by 766 people sampled from a general population to the PROMIS Anxiety scale (http://www.nihpromis.org) composed of 29 Likert-type questions with a common rating scale (1=Never, 2=Rarely, 3=Sometimes, 4=Often, and 5=Always).

Usage

```
data(Anxiety)
```

Format

A data frame with 766 observations on the following 32 variables.

`age` 0=younger than 65 and 1=65 and older

`gender` 0=Male and 1=Female

`education` 0=some college or higher and 1=high school or lower

`R1` I felt fearful

`R2` I felt frightened

`R3` It scared me when I felt nervous

`R4` I felt anxious

`R5` I felt like I needed help for my anxiety

`R6` I was concerned about my mental health

`R7` I felt upset

`R8` I had a racing or pounding heart

`R9` I was anxious if my normal routine was disturbed

`R10` I had sudden feelings of panic

`R11` I was easily startled

`R12` I had trouble paying attention

`R13` I avoided public places or activities

`R14` I felt fidgety

`R15` I felt something awful would happen

`R16` I felt worried

`R17` I felt terrified

`R18` I worried about other people's reactions to me

`R19` I found it hard to focus on anything other than my anxiety

`R20` My worries overwhelmed me

`R21` I had twitching or trembling muscles

`R22` I felt nervous

`R23` I felt indecisive

`R24` Many situations made me worry

`R25` I had difficulty sleeping

`R26` I had trouble relaxing

`R27` I felt uneasy

`R28` I felt tense

`R29` I had difficulty calming down

Source

http://www.nihpromis.org

References

PROMIS Cooperative Group. Unpublished Manual for the Patient-Reported Outcomes Measurement Information System (PROMIS) Version 1.1. October, 2008: http://www.nihpromis.org

Examples

```
## Not run: data(Anxiety)
```

`calcprob` *calculates item response probabilities*

Description

Calculates item response probabilities over a theta grid.

Usage

```
calcprob(ipar, theta)
```

Arguments

`ipar`	a data frame containing the following columns: a, cb1, cb2,..., cb(maxCat)
`theta`	a grid of theta values, e.g., theta <- seq(-4,4,.1)

Details

Calculates an array of item response probabilities according to the graded response model (GRM: Samejima, 1969) over a grid of theta values. Two required input objects are ipar and theta. ipar is a data frame containing item parameters in the following order: a, cb1, cb2,..., cb(maxCat). Items can have different numbers of categories. The variable maxCAT is determined by the function as the maximum number of category threshold parameters across all items plus 1. theta is a vector containing a grid of theta values.

Value

Returns an array of item response probabilities of dimension, c(nq, ni, maxCAT), where nq is the length of the theta grid, ni is the number of items in ipar, i.e., nrow(ipar), and maxCAT is the maximum number of response categories across all items.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Samejima, F. (1969). Estimation of latent ability using a response pattern of graded scores. Psychometrika Monograph, 17.

See Also

probgrm

Examples

```
##item.par<-read.csv(fn,head=F,col.names=c("a","cb1","cb2","cb3"))
##theta <- seq(-4,4,.1)
## Not run: calcprob(item.par,theta)
```

`calctheta` *calculates EAP theta and associated standard error*

Description

Calculates the Expected A Posteriori (EAP) theta and the associated posterior standard deviation (PSD) as standard error estimates.

Usage

```
calctheta(ipar, resp.data, theta, prior.mean = 0, prior.sd = 1)
```

Arguments

`ipar`	a data frame containing the following columns: a, cb1, cb2,..., cb(maxCat)
`resp.data`	a data frame containing item responses
`theta`	a theta grid (quadrature points)
`prior.mean`	prior mean
`prior.sd`	prior standard deviation

Details

Calculates EAP theta estimates and PSD standard error estimates based on the input item parameters (ipar) and the item response data (resp.data).

Value

A list object with the components

`EAP`	Expected A Posteriori estimates of theta
`SE`	Standard Error estimates

Note

Not all item responses may be present.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Bock, R. D. & Mislevy, R. J. (1982). Adaptive EAP Estimation of Ability in a Microcomputer Environment. Applied Psychological Measurement, 6(4), 431-444.

See Also

calcprob, probgrm

Examples

```
## Not run: calctheta(ipar,resp.data)
```

---

collapse *collapses response categories*

Description

collapses response categories if cell frequencies are less than the specified minimum threshold (i.e., minCell) and returns a vector of recoded values.

Usage

```
collapse(resp, group, minCell)
```

Arguments

resp	a vector of item responses
group	a vector of group designations
minCell	a minimum cell frequency

Details

Collapses item response categories in resp if the two-way contingency table (resp x group) has cell frequencies less than the minimum cell count threshold specified by minCell.

Value

a numeric vector of the same length as resp with collapsed/recoded values.

Note

Item responses are expected to start from 1 not 0 (e.g., 1, 2, 3, 4, 5 and not 0, 1, 2, 3, 4). There must be at least two unique categories after collapsing/recoding.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

See Also

recode

Examples

```
r1 <- c(1,1,2,1,1,2,2,1,2,2,1,2,2,1,1,2,1,2,2,3,3,1,2,3)
gr <- c(0,0,0,1,1,0,1,1,0,0,1,0,1,1,0,1,0,1,0,1,0,1,0,1)
collapse(r1,gr,2) #minCell=2
## returns  c(1,1,2,1,1,2,2,1,2,2,1,2,2,1,1,2,1,2,2,2,2,1,2,2)
## response categories 2 and 3 are collapsed
```

---

equate *performs Stocking-Lord Equating*

Description

Computes linear transformation constants to equate a set of GRM/2PL item parameters to a target scale using a common-item test characteristic curve equating procedure (Stocking & Lord, 1983)

Usage

```
equate(ipar.to, ipar.from, theta)
```

Arguments

ipar.to	a data frame containing target item parameters in the following order: a, cb1, cb2,..., cb(ncat-1)
ipar.from	a data frame containing to-be-equated item parameters in the following order: a, cb1, cb2,..., cb(ncat-1)
theta	a theta grid (quadrature points)

Details

Computes linear transformation constants that equate a set of item parameters (ipar.from) to the scale defined by a target item parameters (ipar.to) by minimizing the squared difference between the test characteristic curves as described in Stocking and Lord (1983). The minimization is performed by the nlminb function (in stats).

Value

returns a vector of two elements c(A, X) where A is a multiplicative constant and K is an additive constant

Note

The item parameters are assumed to be on the theta metric (0,1). The number of category threshold parameters can differ across items.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Stocking, M. L. & Lord, F. M. (1983). Developing a Common Metric in Item Response Theory. Applied Psychological Measurement, 7(2), 201-210.

See Also

tcc

Examples

```
##ipar.to is a data frame containing "target" item parameters
##ipar.from is a data frame containing "to-be-equated" item parameters
## Not run: AK <- equate(ipar.to,ipar.from)
#AK[1] contains the multiplicative constant
#AK[2] contains the additive constant
```

---

extract *extracts item parameters*

Description

extracts IRT item parameter estimates from an output returned from ltm:grm

Usage

```
extract(ipar)
```

Arguments

ipar	output from the grm function in the ltm package

Details

similar to the coef function in the ltm package

Value

a data frame containing item parameter estimates in the order of a, cb1, cb2,..., cb(maxCat-1).

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

See Also

lordif

Examples

```
##calib.sparse <- grm(sparse.matrix,constrained=FALSE,IRT.param=TRUE)
## Not run: ipar.sparse <- extract(calib.sparse)
```

---

getcutoff *determines a cutoff threshold*

Description

Determines cutoff thresholds for statistics generated from Monte Carlo simulations

Usage

```
getcutoff(stat, alpha, reverse)
```

Arguments

stat	a vector containing statistics sampled from a Monte Carlo simulation
alpha	a value determining the proportion to be cut off from the bottom (or top) of stat
reverse	if TRUE it cuts off the right tail

Details

if reversed is TRUE it cuts off the right tail (i.e., largest values)

Value

returns a scalar that cuts off the designated proportion (specified by alpha)

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

See Also

montecarlo

Examples

```
#top 1 percent
getcutoff(runif(1000),0.01,TRUE)
#bottom 1 percent
getcutoff(runif(1000),0.01,FALSE)
```

`lordif` *performs LOgistic Regression Differential Item Functioning using IRT*

Description

performs iterative hybrid ordinal logistic regression/IRT DIF

Usage

```
lordif(resp.data, group, selection = NULL,
criterion = c("Chisqr", "R2", "Beta"),
pseudo.R2 = c("McFadden", "Nagelkerke", "CoxSnell"), alpha = 0.01,
beta.change = 0.1, R2.change = 0.02, maxIter = 10, minCell = 5,
minTheta = -4, maxTheta = 4, inc = 0.1, NQ=41)
```

Arguments

`resp.data`	data frame or matrix containing item responses
`group`	a vector of group designations
`selection`	vector specifying a subset of items to be analyzed or NULL for all items
`criterion`	criterion for flagging (i.e., "Chisqr", "R2", or "Beta")
`pseudo.R2`	pseudo R-squared measure (i.e., "McFadden", "Nagelkerke", or "CoxSnell")
`alpha`	significance level for Chi-squared criterion
`beta.change`	proportionate change for Beta criterion
`R2.change`	R-squared change for pseudo R-squared criterion
`maxIter`	maximum number of iterations for purification
`minCell`	minimum cell frequency to avoid collapsing
`minTheta`	minimum for theta grid
`maxTheta`	maximum for theta grid
`inc`	increment for theta grid
`NQ`	number of quadrature points for IRT parameter estimation (maximum of 61)

Details

Performs a ordinal (common odds-ratio) logistic regression DIF analysis using IRT theta estimates as the conditioning variable. The graded response (GR) model is used for IRT trait estimation. Flagged items are treated as separate items and group-specific item parameters are obtained. The procedure runs iteratively until the same set of items is flagged over two iterations.

Value

Returns a list of class "lordif" with the following components:

`call`	calling expression
`options`	options used for the run
`selection`	all or a subset of items analyzed
`stats`	matrix containing output statistics
`flag`	logical vector of final flags indicating whether each item is displaying DIF or not
`recoded`	data frame containing recoded item responses
`group`	vector of group designation values
`ng`	scalar for the number of groups
`ncat`	vector of the number of response categories after collapsing/recoding
`calib`	vector of theta estimates based on the overall (non-group-specific) item parameters
`calib.sparse`	vector of theta estimates based on the group-specific item parameters (for DIF items)
`iteration`	scalar for the number of iterations
`ipar`	data frame of the overall (non-group-specific) item parameter estimates
`ipar.sparse`	data frame of the group-specific item parameter estimates
`stats.raw`	matrix containing output statistics (the same components as stats above but based on raw scores)
`meanraw`	vector containing mean raw scores
`flag.raw`	logical vector of DIF final flags based on raw scores

Note

requires the **ltm** and **rms** packages

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Choi, S. W., Gibbons, L. E., Crane, P. K. (2011). lordif: An R Package for Detecting Differential Item Functioning Using Iterative Hybrid Ordinal Logistic Regression/Item Response Theory and Monte Carlo Simulations. Journal of Statistical Software, 39(8), 1-30. URL http://www.jstatsoft.org/v39/i08/.

Crane, P. K., Gibbons, L. E., Jolley, L., and van Belle, G. (2006). Differential item functioning analysis with ordinal logistic regression techniques: DIF detect and difwithpar. Medical Care, 44(11 Suppl 3), S115-S123.

See Also

`rundif`

Examples

```
## Not run: data(Anxiety)
## Not run: resp.data <- Anxiety[paste("R",1:29,sep="")]
## Not run: age <- Anxiety$age
## Not run: age.DIF <- lordif(resp.data,age)
## Not run: print(age.DIF)
```

`montecarlo` *performs Monte Carlo simulations for empirical cutoff thresholds*

Description

performs Monte Carlo simulations under no-DIF conditions to generate empirical cutoff thresholds

Usage

```
montecarlo(obj, alpha = 0.01, nr = 100)
```

Arguments

`obj`	an object returned from lordif
`alpha`	desired significance level (e.g., .01)
`nr`	number of replications

Details

Simulated datasets are generated under no-DIF conditions and have the same dimensions as the empirical dataset. Group differences (impact) in theta estimates are preserved in the simulated datasets. Returns empirical thresholds for various statistics and effect size measures.

Value

Returns a list of class "lordif.MC" with the following components:

`call`	calling expression
`chi12`	prob associated with the LR Chi-square test comparing Model 1 vs. 2
`chi13`	prob associated with the LR Chi-square test comparing Model 1 vs. 3
`chi23`	prob associated with the LR Chi-square test comparing Model 2 vs. 3
`pseudo12.CoxSnell`	Cox & Snell pseudo R-square change from Model 1 to 2
`pseudo13.CoxSnell`	Cox & Snell pseudo R-square change from Model 1 to 3
`pseudo23.CoxSnell`	Cox & Snell pseudo R-square change from Model 2 to 3
`pseudo12.Nagelkerke`	Nagelkerke pseudo R-square change from Model 1 to 2

`pseudo13.Nagelkerke`
: Nagelkerke pseudo R-square change from Model 1 to 3

`pseudo23.Nagelkerke`
: Nagelkerke pseudo R-square change from Model 2 to 3

`pseudo12.McFadden`
: McFadden pseudo R-square change from Model 1 to 2

`pseudo13.McFadden`
: McFadden pseudo R-square change from Model 1 to 3

`pseudo23.McFadden`
: McFadden pseudo R-square change from Model 2 to 3

`beta12`
: proportional beta change from Model 1 to 2

`alpha`
: significance level

`nr`
: number of replications

`cutoff`
: thresholds for the statistics

Note

nr must be a large integer (e.g., 500) for smooth distributions.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Choi, S. W., Gibbons, L. E., Crane, P. K. (2011). lordif: An R Package for Detecting Differential Item Functioning Using Iterative Hybrid Ordinal Logistic Regression/Item Response Theory and Monte Carlo Simulations. Journal of Statistical Software, 39(8), 1-30. URL http://www.jstatsoft.org/v39/i08/.

See Also

`lordif`

Examples

```
##load PROMIS Anxiety sample data (n=766)
  ## Not run: data(Anxiety)
##age : 0=younger than 65 or 1=65 or older
##run age-related DIF on all 29 items (takes about a minute)
  ## Not run: age.DIF <- lordif(Anxiety[paste("R",1:29,sep="")],Anxiety$age)
##the following takes several minutes
  ## Not run: age.DIF.MC <- montecarlo(age.DIF,alpha=0.01,nr=100)
```

permute *performs permutation test for empirical cutoff thresholds*

Description

performs permutation tests under no-DIF conditions to generate empirical cutoff thresholds

Usage

```
permute(obj, alpha = 0.01, nr = 100)
```

Arguments

obj	an object returned from lordif
alpha	desired significance level (e.g., .01)
nr	number of replications

Details

The vector of group designations is randomly shuffled nr times to estimate the sampling distribution of the statistics when the null hypothesis is true. Returns empirical thresholds for various statistics and effect size measures.

Value

Returns a list of class "lordif.MC" with the following components:

call	calling expression
chi12	prob associated with the LR Chi-square test comparing Model 1 vs. 2
chi13	prob associated with the LR Chi-square test comparing Model 1 vs. 3
chi23	prob associated with the LR Chi-square test comparing Model 2 vs. 3
pseudo12.CoxSnell	Cox & Snell pseudo R-square change from Model 1 to 2
pseudo13.CoxSnell	Cox & Snell pseudo R-square change from Model 1 to 3
pseudo23.CoxSnell	Cox & Snell pseudo R-square change from Model 2 to 3
pseudo12.Nagelkerke	Nagelkerke pseudo R-square change from Model 1 to 2
pseudo13.Nagelkerke	Nagelkerke pseudo R-square change from Model 1 to 3
pseudo23.Nagelkerke	Nagelkerke pseudo R-square change from Model 2 to 3
pseudo12.McFadden	McFadden pseudo R-square change from Model 1 to 2

`pseudo13.McFadden`
: McFadden pseudo R-square change from Model 1 to 3

`pseudo23.McFadden`
: McFadden pseudo R-square change from Model 2 to 3

`beta12`
: proportional beta change from Model 1 to 2

`alpha`
: significance level

`nr`
: number of replications

`cutoff`
: thresholds for the statistics

Note

nr must be a large integer (e.g., 500) for smooth distributions.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Choi, S. W., Gibbons, L. E., Crane, P. K. (2011). lordif: An R Package for Detecting Differential Item Functioning Using Iterative Hybrid Ordinal Logistic Regression/Item Response Theory and Monte Carlo Simulations. Journal of Statistical Software, 39(8), 1-30. URL http://www.jstatsoft.org/v39/i08/.

See Also

`lordif`

Examples

```
##load PROMIS Anxiety sample data (n=766)
  ## Not run: data(Anxiety)
##age : 0=younger than 65 or 1=65 or older
##run age-related DIF on all 29 items (takes about a minute)
  ## Not run: age.DIF <- lordif(Anxiety[paste("R",1:29,sep="")],Anxiety$age)
##the following takes several minutes
  ## Not run: age.DIF.MC <- permute(age.DIF,alpha=0.01,nr=100)
```

---

plot.lordif *Plot method for lordif class*

Description

plots diagnostic graphs for items identified as displaying DIF

Usage

```
  ## S3 method for class 'lordif'
plot(x, labels = c("Reference", "Focal"), ...)
```

Arguments

x	output from lordif
labels	labels for group levels, e.g., c("Male","Female")
...	extra graphical parameters

Details

Generates the following graphs IF there is one or more DIF items: 1. Trait Distributions - density graphs for groups 2. Item True Score Functions - true score functions by theta for groups 3. Differences in Item True Score Functions - unsigned differences 4. Item Response Functions - item response function for groups 5. Impact (Weighted by Density) - unsigned differences weighted by theta distributions for the focal group 6. Comparison of TCCs by group based on all items and DIF items 7. Impact on Theta Estimates - theta estimates by group before and after accounting for DIF

Graphs 2-5 are generated for each DIF item Graphs 1, 6 and 7 are generated for the whole analysis

Note

Produces graphs only if x contains DIF items.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

See Also

lordif

Examples

```
##run lordif first
  ## Not run: age.dif <- lordif(Anxiety[paste("R",1:29,sep="")],Anxiety$age)
  ## Not run: plot(age.dif,labels=c("Younger","Older"),cex=0.8,lwd=1)
```

---

plot.lordif.MC *Plot method for Monte Carlo simulation output*

Description

Produces plots for Monte Carlo output

Usage

```
  ## S3 method for class 'lordif.MC'
plot(x, mfrow = c(3, 1), ...)
```

Arguments

x	an object of class lordif.MC returned from montecarlo
mfrow	number of rows and columns per page for multi-fane plots
...	extra graphical parameters

Details

Generates the following graphs: 1. thresholds for Chi-square probability for Model 1 vs. 2 2. thresholds for Chi-square probability for Model 1 vs. 3 3. thresholds for Chi-square probability for Model 2 vs. 3 4. pseudo R-square change from Model 1 to 2 5. pseudo R-square change from Model 1 to 3 6. pseudo R-square change from Model 2 to 3 7. proportional beta change from Model 1 to 2

Value

Returns no object.

Note

x is an object of class lordif.MC returned from montecarlo

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

See Also

lordif

Examples

```
## s3 plot method for class 'lordif.MC':
## Not run: age.dif <- lordif(Anxiety[paste("R",1:29,sep="")],Anxiety$age)
## Not run: age.dif.MC <- montecarlo(age.dif,alpha=.05,nr=500)
## Not run: plot(age.dif.MC,mfrow=c(1,1))
```

---

probgrm *calculates item response probabilities*

Description

Calculates a matrix of item response probabilities over a grid of theta values for an item

Usage

```
probgrm(theta, a, cb)
```

Arguments

theta	a vector of theta values (e.g., quadrature points)
a	a slope parameter value
cb	a vector of category threshold values

Details

Graded Response Model (Samejima, 1969) is assumed.

Value

Returns a matrix of item response probabilities. The first dimension corresponds to the length of theta.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Samejima, F. (1969). Estimation of latent ability using a response pattern of graded scores. Psychometrika Monograph, 17.

See Also

calcprob

Examples

```
##
probgrm(seq(-4,4,.1), 1.5, c(-1.2,0.5,1.5))
```

---

recode *recodes item responses*

Description

Recodes item responses as specified by original and modified

Usage

```
recode(vec, original, modified)
```

Arguments

vec	a vector of item responses to be recoded
original	original item response categories, e.g., c(0,1,2,3)
modified	modified item response categories, e.g., c(1,2,3,4)

Details

vec, original, and modified must be of the same mode. original and modified must be of the same length.

Value

Returns a vector of the same length and mode as vec with recoded values.

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

Examples

```
x <- c(0,1,2,3,4,0,1,2,3,4)
y <- c(0,1,2,3,4)
z <- c(1,2,3,4,5)
recode(x,y,z)
##returns c(1,2,3,4,5,1,2,3,4,5)
```

---

rundif *runs ordinal logistic regression DIF*

Description

Runs ordinal logistic regression DIF

Usage

```
rundif(item, resp, theta, gr, criterion, alpha, beta.change,
       pseudo.R2, R2.change)
```

Arguments

item	a selection of items to be analyzed
resp	a data frame containing item responses
theta	a conditioning (matching) variable
gr	a vector of group identifiers
criterion	criterion for flagging (i.e., "CHISQR", "R2", or "BETA")
alpha	significance level for Chi-squared criterion
beta.change	proportional change for Beta criterion
pseudo.R2	pseudo R-squared measure (i.e., "McFadden", "Nagelkerke", or "CoxSnell")
R2.change	R-squared change for pseudo R-squared criterion

Details

The argument item lists the column numbers of the data frame resp to be included in the analysis.

Value

Returns a list of the following components:

`stats`	a data frame containing output statistics
`flag`	a logical vector of DIF flags

Author(s)

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References

Choi, S. W., Gibbons, L. E., Crane, P. K. (2011). lordif: An R Package for Detecting Differential Item Functioning Using Iterative Hybrid Ordinal Logistic Regression/Item Response Theory and Monte Carlo Simulations. Journal of Statistical Software, 39(8), 1-30. URL http://www.jstatsoft.org/v39/i08/.

Crane, P. K., Gibbons, L. E., Jolley, L., and van Belle, G. (2006). Differential item functioning analysis with ordinal logistic regression techniques: DIF detect and difwithpar. Medical Care, 44(11 Suppl 3), S115-S123.

See Also

`runolr`, `lordif`

Examples

```
##
## Not run: rundif(item,resp,theta,gr)
```

---

runolr *runs ordinal logistic regression models*

Description

Runs ordinal logistic regression models and produces DIF statistics and effect size measures

Usage

```
runolr(rv, ev, gr)
```

Arguments

`rv`	a response variable
`ev`	an explanatory variable (e.g., conditioning variable)
`gr`	a vector of group identifiers

Details

Model 1: ev Model 2: ev + gr Model 3: ev*gr or equivalently ev + gr + ev*gr

Value

Returns a list of the following components:

`chi12` prob for the LR Chi-square comparing Model 1 vs. Model 2

`chi13` prob for the LR Chi-square comparing Model 1 vs. Model 3

`chi23` prob for the LR Chi-square comparing Model 2 vs. Model 3

`beta12` proportional change in the coefficient for ev

`pseudo1.CoxSnell` Cox & Snell psudo R-square for Model 1

`pseudo2.CoxSnell` Cox & Snell psudo R-square for Model 2

`pseudo3.CoxSnell` Cox & Snell psudo R-square for Model 1

`pseudo1.Nagelkerke` Nagelkerke psudo R-square for Model 1

`pseudo2.Nagelkerke` Nagelkerke psudo R-square for Model 2

`pseudo3.Nagelkerke` Nagelkerke psudo R-square for Model 3

`pseudo1.McFadden` McFadden psudo R-square for Model 1

`pseudo2.McFadden` McFadden psudo R-square for Model 2

`pseudo3.McFadden` McFadden psudo R-square for Model 3

`pseudo12.CoxSnell` Cox & Snell R-square change from Model 1 to Model 2

`pseudo13.CoxSnell` Cox & Snell R-square change from Model 1 to Model 3

`pseudo23.CoxSnell` Cox & Snell R-square change from Model 2 to Model 3

`pseudo12.Nagelkerke` Nagelkerke R-square change from Model 1 to Model 2

`pseudo13.Nagelkerke` Nagelkerke R-square change from Model 1 to Model 3

`pseudo23.Nagelkerke` Nagelkerke R-square change from Model 2 to Model 3

`pseudo12.McFadden` McFadden R-square change from Model 1 to Model 2

`pseudo13.McFadden`
: McFadden R-square change from Model 1 to Model 3

`pseudo23.McFadden`
: McFadden R-square change from Model 2 to Model 3

`df12`
: df for the LR Chi-square comparing Model 1 and Model 2

`df13`
: df for the LR Chi-square comparing Model 1 and Model 3

`df23`
: df for the LR Chi-square comparing Model 2 and Model 3

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Choi, S. W., Gibbons, L. E., Crane, P. K. (2011). lordif: An R Package for Detecting Differential Item Functioning Using Iterative Hybrid Ordinal Logistic Regression/Item Response Theory and Monte Carlo Simulations. Journal of Statistical Software, 39(8), 1-30. URL http://www.jstatsoft.org/v39/i08/.

Crane, P. K., Gibbons, L. E., Jolley, L., & van Belle, G. (2006). Differential item functioning analysis with ordinal logistic regression techniques: DIF detect and difwithpar. Medical Care, 44(11 Suppl 3), S115-S123.

See Also

`rundif`, `lordif`

Examples

```
##
## Not run: runolr(rv, ev, gr)
```

---

separate *splits item response vectors of DIF items by group*

Description

Splits item response vectors of DIF items into separate group-specific vectors.

Usage

```
separate(resp, flag, gr)
```

Arguments

`resp`
: a data frame (or matrix) of item response vectors

`flag`
: a vector of DIF flags

`gr`
: a vector of group identifiers

Details

To obtain group specific item calibrations, response vectors of DIF items are split into multiple vectors by group and treated as separate items.

Value

Returns a data frame with item response vectors for non-DIF items followed by separated item response vectors for DIF items

Author(s)

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See Also

lordif

Examples

```
##
## Not run: separate(resp,flag,gr)
```

---

tcc *computes a test characteristic curve (tcc)*

Description

computes a test characteristic curve (tcc) from input item parameters

Usage

```
tcc(a, cb, theta)
```

Arguments

a	a vector of slope parameters
cb	a matrix of category boundary/threshold parameters
theta	a grid of theta values

Details

The graded response model is assumed. The lowest score for each item is set to 0 not 1. length(a) must be the same as nrow(cb)

Value

Retruns a vector representing a tcc

Author(s)

Seung W. Choi <s-choi@northwestern.edu>

References

Samejima, F. (1969). Estimation of latent ability using a response pattern of graded scores. Psychometrika Monograph, 17.

See Also

equate, probgrm

Examples

```
##
## Not run: tcc(a,cb,theta)
```

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