Package 'ConjointChecks'

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Type Package

Title Implementation of a Method to Check the Cancellation Axioms of Additive Conjoint Measurement

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Depends R (>= 4.3), parallel, methods,

Description Implementation of a procedure---Domingue (2012) <https://eric.ed.gov/?id=ED548657>, Domingue (2014) <doi:10.1007/s11336-013-9342-4>; see also Karabatsos (2001) <https://psycnet.apa.org/record/2002-01665-005> and Kyngdon (2011) <doi:10.1348/2044-8317.002004>---to test the single and double cancellation axioms of conjoint measure in data that is dichotomously coded and measured with error.

URL https://github.com/ben-domingue/ConjointChecks

LazyData Yes

Imports Rcpp

LinkingTo Rcpp

License GPL (>= 2)

NeedsCompilation yes

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Repository CRAN

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Contents

ConjointChecks-package

> *ConjointChecks: A package to check the cancellation axioms of conjoint measurement.*

Description

Implementation of a procedure (Domingue, 2012; see also Karabatsos, 2001 and Kyngdon, 2011) to test the single and double cancellation axioms of conjoint measure in data that is dichotomously coded and measured with error.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Domingue, B. (2012). Evaluating the Equal-Interval Hypothesis with Test Score Scales. Doctoral Dissertation, University of Colorado Boulder, May 2012.

Karabatsos, G. (2001). The rasch model, additive conjoint measurement, and new models of probabilistic measurement theory. Journal of Applied Measurement, 2(4), 389-423.

Kyngdon, A. (2011). Plausible measurement analogies to some psychometric models of test performance. British Journal of Mathematical and Statistical Psychology, 64(3), 478-497.

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

CCIterate	*Internal Function of Iterations of ConjointChecks*

Description

Internal function; should not be used directly.

Usage

```
CCIterate(nIter, old, old_ll, single, burn, N, n)
```

Arguments

nIter	Number of iterations.
old	Numeric matrix.
old_ll	Numeric matrix.
single	Should do single cancellation.
burn	Number of initial values to remove.
N	Integer matrix.
n	Numeric matrix.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
### INTERNAL FUNCTION ###
```

---

checks-class   *Class "checks"*

Description

The formal S4 class for checks. This class contains transformed version of the raw response data as well as summaries of the checks.

Details

Objects of class checks contains all information returned by ConjointChecks.

Objects from the Class

Object created by a call to function ConjointChecks.

Slots

N: matrix containing the number of respondents at each item/ability intersection

n: matrix containing the number of correct responses at each item/ability intersection

Checks: List containing information about each checked 3-matrix

tab: matrix containing information about the detected violations at each item/ability intersection

means: vector containing weighted and unweighted means for the detected violations (where weights are the number of individuals at each ability level)

check.counts: matrix giving the number of times a item/ability cell was sampled

Author(s)

Ben Domingue <ben.domingue@gmail.com>

See Also

ConjointChecks, summary.checks, plot.checks

ConjointChecks   *Check Single and Double Cancellation in a sample of 3-matrices*

Description

Given two matrices, n and N (which contain the number of correct responses and the number of total responses for each cell), a check of single and double cancellation is performed in n.3mat matrices. To check large numbers of 3-matrices (to see why, see Domingue (2012)), parallel options help.

Usage

```
ConjointChecks(N,n,n.3mat=1,CR=c(.025,.975),single=FALSE,mc.cores=1)
```

Arguments

N	Matrix containing the total number of responses.
n	Matrix containing the number of correct responses.
n.3mat	Number of 3-matrices to sample or the string "adjacent" if all adjacently formed 3-matrices are to be checked.
CR	Width of the credible region taken from the posterior. Defaults to a 95% credible region (c(.025,.975)).
single	Also test single cancellation.
mc.cores	The number of cores to parallelize over.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
#######################################################
#parole data
#page 244 (table 2) of Perline, Wright, and Wainer
#about 9% were bad in perline
matrix(c(15,47,61,84,82,86,60,47,8),9,9,byrow=FALSE)->N
per <-structure(c(0, 0.06, 0.07, 0.18, 0.13, 0.13, 0.17, 0.17,
 1, 0, 0.04, 0.15, 0.24, 0.33, 0.28, 0.47, 0.85, 1, 0, 0.04, 0.08,
 0.12, 0.3, 0.64, 0.85, 1, 1, 0, 0.19, 0.39, 0.4, 0.51, 0.58,
 0.82, 0.98, 1, 0, 0.06, 0.18, 0.52, 0.73, 0.95, 1, 1, 1, 0,
 0.23, 0.33, 0.51, 0.68, 0.91, 0.93, 1, 1, 0.27, 0.51, 0.61,
 0.64, 0.68, 0.77, 0.9, 1, 1, 0, 0.21, 0.52, 0.68, 0.84, 0.97,
 0.97, 1, 1, 0.73, 0.64, 0.67, 0.7, 0.78, 0.78, 0.9, 1, 1),
 .Dim = c(9L, 9L) )
round(per*N)->n
ConjointChecks(N,n,n.3mat=1)->out

#######################################################
#Data from Rasch (1960) data
#page 250 (table 5) of Perline, Wright, and Wainer
#about 4% showed violations
matrix(c(49,112,32,76,82,102,119,133,123,94,61,17,10),13,7,byrow=FALSE)->N
per <-structure(c(0, 0, 0, 0, 0.02, 0.01, 0.02, 0.03, 0.06, 0.09,
 0.23, 0.35, 0.7, 0.01, 0, 0.04, 0.05, 0.09, 0.09, 0.16, 0.28, 0.39,
 0.66, 0.8, 0.91, 0.85, 0, 0.02, 0.07, 0.07, 0.24, 0.28, 0.45, 0.59,
```

```
 0.76, 0.87, 0.9, 1, 0.85, 0.01, 0.04, 0.12, 0.21, 0.42, 0.62, 0.73,
 0.83, 0.9, 0.93, 0.98, 1, 1, 0.06, 0.11, 0.4, 0.7, 0.7, 0.79, 0.84,
 0.88, 0.94, 0.95, 0.98, 1, 1, 0.48, 0.84, 0.84, 0.86, 0.86, 0.9,
 0.95, 0.96, 0.98, 0.99, 0.99, 1, 1, 0.92, 0.98, 0.98, 0.99, 0.98,
 0.99, 0.99, 1, 1, 1, 1, 1, 1), .Dim = c(13L, 7L))
round(per*N)->n
ConjointChecks(N,n,n.3mat=1)->out

###########
#simulated rasch example
n.3mat<-1000
n.items<-20
n.respondents<-2000
#simulate data
rnorm(n.items)->diff
rnorm(n.respondents)->abil
matrix(abil,n.respondents,n.items,byrow=FALSE)->m1
matrix(diff,n.respondents,n.items,byrow=TRUE)->m2
m1-m2 -> kern
exp(kern)/(1+exp(kern))->pv
runif(n.items*n.respondents)->test
ifelse(pv>test,1,0)->resp
##now check
PrepareChecks(resp)->tmp
ConjointChecks(tmp$N,tmp$n,n.3mat=n.3mat,mc.cores=1)->rasch1000
```

DoubleCancel   *Check Double Cancellation in a sample of 3-matrices*

Description

Internal function. Wrapper of the code that checks ONLY the double cancellation bits.

Usage

```
DoubleCancel(N,n,n.3mat=1,CR=c(.025,.975),mc.cores=1)
```

Arguments

N	Matrix containing the total number of responses.
n	Matrix containing the number of correct responses.
n.3mat	Number of 3-matrices to sample or the string "adjacent" if all adjacently formed 3-matrices are to be checked.
CR	Width of the credible region taken from the posterior. Defaults to a 95% credible region (c(.025,.975)).
mc.cores	The number of cores to parallelize over.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
### INTERNAL FUNCTION ###
```

---

list.null-class   *Class "list.null"*

Description

The formal S4 class for list.null. This class contains a null list.

Details

Objects of class are used internally.

Objects from the Class

Object used internally.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

See Also

ConjointChecks, summary.checks, plot.checks

ManyBands   *Check What Ordering to Use*

Description

Internal funcion. This checks to see whether the p-value (rasch difficulty) ordering should be used or if ordering should be 'as is'.

Usage

```
ManyBands(th, se, cc.type, resp, bands=seq(10,50,by=10), uniform.bands=TRUE,
          trim.window=NULL, pv.order=TRUE,mc.cores=1)
```

Arguments

th	Threshold.
se	Standard error.
cc.type	Type of cancellation check.
resp	resp.
bands	Values of the bands.
uniform.bands	Is the distribution of the bands uniform?
trim.window	trim.window.
pv.order	Use the p-value ordering.
mc.cores	The number of cores to parallelize over.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
### INTERNAL FUNCTION ###
```

---

omni.check   *Check Single and Double Cancellation in a sample of 3-matrices*

Description

Internal function. This checks both single and double cancellation.

Usage

```
omni.check(N,n,n.iter,burn=1000,thin=4,CR,single)
```

Arguments

N	Matrix containing the total number of responses.
n	Matrix containing the number of correct responses.
n.iter	Total number of samples.
burn	Number of initial samples that should be discarded.
thin	Amount of thinning.
CR	Width of the credible region taken from the posterior. Defaults to a 95% credible region (`c(.025,.975)`).
single	Also test single cancellation.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
### INTERNAL FUNCTION ###
```

---

omni.check_double *Check Double Cancellation in a sample of 3-matrices*

Description

Internal function. Checks ONLY the double cancellation bits.

Usage

```
omni.check_double(N,n,n.iter,burn=1000,thin=4,CR)
```

Arguments

N	Matrix containing the total number of responses.
n	Matrix containing the number of correct responses.
n.iter	Total number of samples.
burn	Number of initial samples that should be discarded.
thin	Amount of thinning.
CR	Width of the credible region taken from the posterior. Defaults to a 95% credible region (c(.025,.975)).

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
### INTERNAL FUNCTION ###
```

---

omni.check_single *Check Single Cancellation in a sample*

Description

Internal function. Code that checks ONLY the single cancellation bits.

Usage

```
omni.check_single(N,n,n.iter,burn=1000,thin=4,CR,single)
```

Arguments

N	Matrix containing the total number of responses.
n	Matrix containing the number of correct responses.
n.iter	Total number of samples.
burn	Number of initial samples that should be discarded.
thin	Amount of thinning.
CR	Width of the credible region taken from the posterior. Defaults to a 95% credible region (c(.025,.975)).
single	Also test single cancellation.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
### INTERNAL FUNCTION ###
```

---

plot.checks	*Plot checks produced by* ConjointChecks.

Description

Takes output from ConjointChecks and produces a matplot showing the percentage of reported violations at each cell.

Usage

```
## S3 method for class 'checks'
plot(x,items=NULL,item.labels=TRUE,...)
```

Arguments

x	Object returned by ConjointChecks of class checks.
items	Vector of item numbers to include in a single plot. Defaults to all, but this is less helpful for diagnostic purposes.
item.labels	Should item numbers be included? Defaults to TRUE. If length of items is unity (perhaps if the small multiple format of Tufte, 2001 is going to be used), then the item number gets printed below the x-axis. If the length of items is more than unity, the item number gets plotted in the figure above the largest proportion of violations for each item.
...	further arguments passed to or from other methods

Value

No return value, called for side effects

References

Tufte, E. R. (2001). The visual display of quantitative information (2nd ed.). Chesire, CT: Graphics Press.

Examples

```
opar <- par()
par(mfrow=c(3,2))
plot(rasch1000)
plot(rasch1000,items=c(5,10,15))
for (i in c(3,9,13,18)) plot(rasch1000,items=i)
par(opar)
```

PrepareChecks   *Prepare raw response data for* ConjointChecks.

Description

Takes output from ConjointChecks and produces a matrix showing the percentage of reported violations at each cell.

Usage

```
PrepareChecks(resp,ss.lower=10, collapse.columns = FALSE)
```

Arguments

resp	Raw dichotomously coded response data. Columns represent items and rows represent individuals.
ss.lower	Only sum scores that have at least this many distinct individuals with that sum score will be used.
collapse.columns	
	Sum over columns.

Value

Returns n and N, respectively, containing the number of correct responses and the number of total responses for each cell.

Examples

```
#simulated Rasch example
n.items<-20
n.respondents<-2000
#simulate data
rnorm(n.items)->diff
rnorm(n.respondents)->abil
matrix(abil,n.respondents,n.items,byrow=FALSE)->m1
matrix(diff,n.respondents,n.items,byrow=TRUE)->m2
m1-m2 -> kern
exp(kern)/(1+exp(kern))->pv
runif(n.items*n.respondents)->test
ifelse(pv>test,1,0)->resp
#now check
PrepareChecks(resp)->obj
```

---

rasch1000   *1000 sampled 3-matrices from simulated Rasch data.*

Description

Object created by first generating Rasch data and then running ConjointChecks on 1000 sampled 3 matrices

Usage

```
rasch1000
```

Format

An object of class checks.

Source

Simulated via Rasch model.

SingleCancel   *Check Single Cancellation in a sample*

Description

Internal function. Wrapper of the code that checks ONLY the single cancellation bits.

Usage

```
SingleCancel(N,n,CR=c(.025,.975),single,mc.cores=1)
```

Arguments

N	Matrix containing the total number of responses.
n	Matrix containing the number of correct responses.
CR	Width of the credible region taken from the posterior. Defaults to a 95% credible region (c(.025,.975)).
single	Also test single cancellation.
mc.cores	The number of cores to parallelize over.

Author(s)

Ben Domingue <ben.domingue@gmail.com>

References

Perline, R., Wright, B. D., & Wainer, H. (1979). The Rasch model as additive conjoint measurement. Applied Psychological Measurement, 3(2), 237-255.

Examples

```
### INTERNAL FUNCTION ###
```

---

summary.checks   *Summarize checks produced by* ConjointChecks.

Description

Takes output from ConjointChecks and produces a matrix showing the percentage of reported violations at each cell.

Usage

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

Arguments

object	Object returned by ConjointChecks of class checks.
...	further arguments passed to or from other methods

Value

No return value, called for side effects

Examples

```
summary(rasch1000)
```

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