Package ‘rpf’

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Description Factor out logic
and math common to Item Factor Analysis fitting, diagnostics, and
analysis. It is envisioned as core support code suitable for more
specialized IRT packages to build upon. Complete access to optimized C
functions are made available with R_RegisterCCallable().
This software is described in Pritikin & Falk (2020) <doi:10.1177/0146621620929431>.
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An introduction

rpf - Response Probability Functions

Description

Factor out logic and math common to Item Factor Analysis fitting, diagnostics, and analysis. It is envisioned as core support code suitable for more specialized IFA packages to build upon.

Details

This package provides optimized, low-level functions to map parameters to response probabilities for dichotomous (1PL, 2PL and 3PL) rpf.drm and polytomous (graded response rpf.grm, partial credit/generalized partial credit (via the nominal model), and nominal rpf.nrm items.

Item model parameters are passed around as a numeric vector. A 1D matrix is also acceptable. Regardless of model, parameters are always ordered as follows: discrimination/slope ("a"), difficulty/intercept ("b"), and pseudo guessing/upper-bound ("g"/"u"). If person ability ranges from negative to positive then probabilities are output from incorrect to correct. That is, a low ability person (e.g., ability = -2) will be more likely to get an item incorrect than correct. For example, a dichotomous model that returns [.25, .75] indicates a probability of .25 for incorrect and .75 for correct. A polytomous model will have the most incorrect probability at index 1 and the most correct probability at the maximum index.

All models are always in the logistic metric. To obtain normal ogive discrimination parameters, divide slope parameters by rpf.ogive. Item models are estimated in slope-intercept form. Input/output matrices arranged in the way most convenient for low-level processing in C. The maximum absolute logit is 35 because f(x) := 1-exp(x) loses accuracy around f(-35) and equals 1 at f(-38) due to the limited accuracy of double precision floating point.

This package could also accrete functions to support plotting (but not the actual plot functions).

References


as.IFAgroup

See Also

See rpf.rparam to create item parameters.

as.IFAgroup  Convert an OpenMx MxModel object into an IFA group

Description

When “minItemsPerScore” is passed, EAP scores will be computed from the data and stored. Scores
are required for some diagnostic tests. See discussion of “minItemsPerScore” in EAPscores.

Usage

as.IFAgroup(
  mxModel,
  data = NULL,
  container = NULL,
  ...,
  minItemsPerScore = NULL
)

Arguments

mxModel  MxModel object
data  observed data (otherwise the data will be taken from the mxModel)
container  an MxModel in which to search for the latent distribution matrices
...  Not used. Forces remaining arguments to be specified by name.
minItemsPerScore  minimum number of items required to compute a score (also see description)

Value

a groups with item parameters and latent distribution

Format of a group

A model, or group within a model, is represented as a named list.

spec  list of response model objects
param  numeric matrix of item parameters
free  logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
mean  numeric vector giving the mean of the latent distribution
cov  numeric matrix giving the covariance of the latent distribution
data  data.frame containing observed item responses, and optionally, weights and frequencies
bestToOmit

score factors scores with response patterns in rows

weightColumn name of the data column containing the numeric row weights (optional)

freqColumn name of the data column containing the integral row frequencies (optional)

qwidth width of the quadrature expressed in Z units

qpoints number of quadrature points

minItemsPerScore minimum number of non-missing items when estimating factor scores

The param matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in spec and order of columns in param are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by param colnames.

Currently only a multivariate normal distribution is available, parameterized by the mean and cov. If mean and cov are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by EAPscores.

See Also

ifaTools

---

bestToOmit Identify the columns with most missing data

Description

If a reference column is given then only rows that are not missing on the reference column are considered. Otherwise all rows are considered.

Usage

bestToOmit(grp, omit, ref = NULL)

Arguments

group a list containing the model and data. See the details section.

omit the maximum number of items to omit

ref the reference column (optional)
Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores

The **param** matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in **spec** and order of columns in **param** are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by **param** colnames.

Currently only a multivariate normal distribution is available, parameterized by the **mean** and **cov**. If **mean** and **cov** are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, **qwidth=2** and **qpoints=5** would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by **EAPscores**.

See Also

Other scoring: **EAPscores()**, **itemOutcomeBySumScore()**, **observedSumScore()**, **omitItems()**, **omitMostMissing()**, **sumScoreEAP()**

Description

Item Factor Analysis makes two assumptions: (1) that the latent distribution is reasonably approximated by the multivariate Normal and (2) that items are conditionally independent. This test examines the second assumption. The presence of locally dependent items can inflate the precision of estimates causing a test to seem more accurate than it really is.
Usage

ChenThissen1997(
  grp,
  ..., 
  data = NULL, 
  inames = NULL, 
  qwidth = 6, 
  qpoints = 49, 
  method = "pearson", 
  .twotier = TRUE, 
  .parallel = TRUE 
)

Arguments

  grp a list containing the model and data. See the details section.
  ... Not used. Forces remaining arguments to be specified by name.
  data data [Deprecated]
  inames a subset of items to examine
  qwidth [Deprecated]
  qpoints [Deprecated]
  method method to use to calculate P values. The default is the Pearson X^2 statistic. Use "lr" for the similar likelihood ratio statistic.
  .twotier whether to enable the two-tier optimization
  .parallel whether to take advantage of multiple CPUs (default TRUE)

Details

Statically significant entries suggest that the item pair has local dependence. Since log(.01)=-4.6, an absolute magnitude of 5 is a reasonable cut-off. Positive entries indicate that the two item residuals are more correlated than expected. These items may share an unaccounted for latent dimension. Consider a redesign of the items or the use of testlets for scoring. Negative entries indicate that the two item residuals are less correlated than expected.

Value

a list with raw, pval and detail. The pval matrix is a lower triangular matrix of log P values with the sign determined by relative association between the observed and expected tables (see ordinal.gamma)

Format of a group

A model, or group within a model, is represented as a named list.

spec list of response model objects
param numeric matrix of item parameters
Class rpf.1dim

free logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
mean numeric vector giving the mean of the latent distribution
cov numeric matrix giving the covariance of the latent distribution
data data.frame containing observed item responses, and optionally, weights and frequencies
score factors scores with response patterns in rows
weightColumn name of the data column containing the numeric row weights (optional)
freqColumn name of the data column containing the integral row frequencies (optional)
qwidth width of the quadrature expressed in Z units
qpoints number of quadrature points
minItemsPerScore minimum number of non-missing items when estimating factor scores

The param matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in spec and order of columns in param are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by param colnames.

Currently only a multivariate normal distribution is available, parameterized by the mean and cov. If mean and cov are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by EAPscores.

References


See Also

ifaTools

Other diagnostic: SitemFit(), SitemFit(), multinomialFit(), rpf.1dim.fit(), sumScoreEAPTest()
Class rpf.1dim.drm  
Unidimensional dichotomous item models (1PL, 2PL, and 3PL).

Description
Unidimensional dichotomous item models (1PL, 2PL, and 3PL).

Class rpf.1dim.gpcmp  
Unidimensional generalized partial credit monotonic polynomial.

Description
Unidimensional generalized partial credit monotonic polynomial.

Class rpf.1dim.graded  
The base class for 1 dimensional graded response probability functions.

Description
This class contains methods common to both the generalized partial credit model and the graded response model.

Class rpf.1dim.grm  
The unidimensional graded response item model.

Description
The unidimensional graded response item model.

Class rpf.1dim.grmp  
Unidimensional graded response monotonic polynomial.

Description
Unidimensional graded response monotonic polynomial.
Class rpf.1dim.lmp

**Description**

Unidimensional logistic function of a monotonic polynomial.

Class rpf.base

**Description**

The base class for response probability functions.

Item specifications should not be modified after creation.

Class rpf.mdim

**Description**

The base class for multi-dimensional response probability functions.

Class rpf.mdim.drm

**Description**

Multidimensional dichotomous item models (M1PL, M2PL, and M3PL).

Class rpf.mdim.graded

**Description**

The base class for multi-dimensional graded response probability functions.

This class contains methods common to both the generalized partial credit model and the graded response model.
Class rpf.mdim.grm  
*The multidimensional graded response item model.*

**Description**

The multidimensional graded response item model.

Class rpf.mdim.mcm  
*The multiple-choice response item model (both unidimensional and multidimensional models have the same parameterization).*

**Description**

The multiple-choice response item model (both unidimensional and multidimensional models have the same parameterization).

Class rpf.mdim.nrm  
*The nominal response item model (both unidimensional and multidimensional models have the same parameterization).*

**Description**

The nominal response item model (both unidimensional and multidimensional models have the same parameterization).

collapseCategoricalCells

*Collapse small sample size categorical frequency counts*

**Description**

Collapse small sample size categorical frequency counts

**Usage**

collapseCategoricalCells(observed, expected, minExpected = 1)
compressDataFrame

Arguments

- observed: the observed frequency table
- expected: the expected frequency table
- minExpected: the minimum expected cell frequency

Pearson’s $X^2$ test requires some minimum frequency per cell to avoid an inflated false positive rate. This function will merge cells with the lowest frequency counts until all the counts are above the minimum threshold. Cells that have been merged are filled with NAs. The resulting tables and number of merged cells is returned.

Examples

```r
O = matrix(c(7,31,42,20,0), 1,5)
E = matrix(c(3,39,50,8,0), 1,5)
collapseCategoricalCells(O,E,9)
```
crosstabTest

Monte-Carlo test for cross-tabulation tables

Description

[Experimental] This is for developers.

Usage

crosstabTest(ob, ex, trials)

Arguments

  ob    observed table
  ex    expected table
  trials number of Monte-Carlo trials

EAPscores

Compute Expected A Posteriori (EAP) scores

Description

If you have missing data then you must specify minItemsPerScore. This option will set scores to NA when there are too few items to make an accurate score estimate. If you are using the scores as point estimates without considering the standard error then you should set minItemsPerScore as high as you can tolerate. This will increase the amount of missing data but scores will be more accurate. If you are carefully considering the standard errors of the scores then you can set minItemsPerScore to 1. This will mimic the behavior of most other IFA software wherein scores are estimated if there is at least 1 non-NA item for the score. However, it may make more sense to set minItemsPerScore to 0. When set to 0, all NA rows are scored to the prior distribution.

Usage

EAPscores(grp, ..., compressed = FALSE)

Arguments

  grp    a list containing the model and data. See the details section.
  ...   Not used. Forces remaining arguments to be specified by name.
  compressed    output one score per observed data row even when freqColumn is set (default FALSE)

Details

Output is not affected by the presence of a weightColumn.
Format of a group

A model, or group within a model, is represented as a named list.

spec  list of response model objects

param numeric matrix of item parameters

free  logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)

mean numeric vector giving the mean of the latent distribution

cov numeric matrix giving the covariance of the latent distribution

data data.frame containing observed item responses, and optionally, weights and frequencies

score factors scores with response patterns in rows

weightColumn name of the data column containing the numeric row weights (optional)

freqColumn name of the data column containing the integral row frequencies (optional)

qwidth width of the quadrature expressed in Z units

qpoints number of quadrature points

minItemsPerScore minimum number of non-missing items when estimating factor scores

The param matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in spec and order of columns in param are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by param colnames.

Currently only a multivariate normal distribution is available, parameterized by the mean and cov. If mean and cov are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by EAPscores.

See Also

Other scoring: bestToOmit(), itemOutcomeBySumScore(), observedSumScore(), omitItems(), omitMostMissing(), sumScoreEAP()

Examples

spec <- list()
spec[1:3] <- list(rpf.grm(outcomes=3))
param <- sapply(spec, rpf.rparam)
data <- rpf.sample(5, spec, param)
colnames(param) <- colnames(data)
grp <- list(spec=spec, param=param, data=data, minItemsPerScore=1L)
EAPscores(grp)
expandDataFrame  

Expand summary table of patterns and frequencies

Description

Expand a summary table of unique response patterns to a full sized data-set.

Usage

expandDataFrame(tabdata, freqName = NULL)

Arguments

- **tabdata**: An object of class `data.frame` with the unique response patterns and the number of frequencies
- **freqName**: Column name containing the frequencies

Value

Returns a data frame with all the response patterns

Author(s)

Based on code by Phil Chalmers <rphilip.chalmers@gmail.com>

Examples

```r
data(LSAT7)
expandDataFrame(LSAT7, freqName="freq")
```

fromFactorLoading  

Convert factor loadings to response function slopes

Description

Convert factor loadings to response function slopes

Usage

fromFactorLoading(loading, ogive = rpf.ogive)

Arguments

- **loading**: a matrix with items in the rows and factors in the columns
- **ogive**: the ogive constant (default `rpf.ogive`)
fromFactorThreshold

Value

a slope matrix with items in the columns and factors in the rows

See Also

Other factor model equivalence: fromFactorThreshold(), toFactorLoading(), toFactorThreshold()

fromFactorThreshold Convert factor thresholds to response function intercepts

Description

Convert factor thresholds to response function intercepts

Usage

fromFactorThreshold(threshold, loading, ogive = rpf.ogive)

Arguments

threshold a matrix with items in the columns and thresholds in the rows
loading a matrix with items in the rows and factors in the columns
ogive the ogive constant (default rpf.ogive)

Value

an item intercept matrix with items in the columns and intercepts in the rows

See Also

Other factor model equivalence: fromFactorLoading(), toFactorLoading(), toFactorThreshold()

itemOutcomeBySumScore Produce an item outcome by observed sum-score table

Description

Produce an item outcome by observed sum-score table

Usage

itemOutcomeBySumScore(grp, mask, interest)
Arguments

- **grp**: a list containing the model and data. See the details section.
- **mask**: a vector of logicals indicating which items to include
- **interest**: index or name of the item of interest

Format of a group

A model, or group within a model, is represented as a named list.

```r
spec  list of response model objects
param numeric matrix of item parameters
free  logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
mean numeric vector giving the mean of the latent distribution
cov  numeric matrix giving the covariance of the latent distribution
data  data.frame containing observed item responses, and optionally, weights and frequencies
score factors scores with response patterns in rows
weightColumn name of the data column containing the numeric row weights (optional)
freqColumn name of the data column containing the integral row frequencies (optional)
qwidth width of the quadrature expressed in Z units
qpoints number of quadrature points
minItemsPerScore minimum number of non-missing items when estimating factor scores
```

The `param` matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in `spec` and order of columns in `param` are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by `param` colnames.

Currently only a multivariate normal distribution is available, parameterized by the `mean` and `cov`. If `mean` and `cov` are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, `qwidth=2` and `qpoints=5` would produce points `-2, -1, 0, 1, and 2`. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by `EAPscores`.

See Also

Other scoring: `EAPscores()`, `bestToOmit()`, `observedSumScore()`, `omitItems()`, `omitMostMissing()`, `sumScoreEAP()`

Examples

```r
set.seed(1)
spec <- list()
spec[1:3] <- rpf.grm(outcomes=3)
param <- sapply(spec, rpf.rparam)
```
kct

k Knox Cube Test dataset

Description

These data from Wright & Stone (1979, p. 31) were fit with Winsteps 3.73 using a 1PL model (slope fixed to 1).

References


Examples

data(kct)

logit

Transform from [0,1] to the reals

Description

The logit function is a standard transformation from [0,1] (such as a probability) to the real number line. This function is exactly the same as qlogis.

Usage

logit(p, location = 0, scale = 1, lower.tail = TRUE, log.p = FALSE)

Arguments

p a number between 0 and 1
location see qlogis
scale see qlogis
lower.tail see qlogis
log.p see qlogis

See Also

qlogis, plogis
Examples

\begin{verbatim}
logit(.5)  # 0
logit(.25) # -1.098
logit(0)   # -Inf
\end{verbatim}

---

**LSAT6**

*Description of LSAT6 data*

**Description**

Data from Thissen (1982); contains 5 dichotomously scored items obtained from the Law School Admissions Test, section 6.

**Author(s)**

Phil Chalmers <rphilip.chalmers@gmail.com>

**References**


**Examples**

data(LSAT6)

---

**LSAT7**

*Description of LSAT7 data*

**Description**

Data from Bock & Lieberman (1970); contains 5 dichotomously scored items obtained from the Law School Admissions Test, section 7.

**Author(s)**

Phil Chalmers <rphilip.chalmers@gmail.com>

**References**


**Examples**

data(LSAT7)
multinomialFit

multinomialFit  Multinomial fit test

Description
For degrees of freedom, we use the number of observed statistics (incorrect) instead of the number of possible response patterns (correct) (see Bock, Gibbons, & Muraki, 1998, p. 265). This is not a huge problem because this test becomes poorly calibrated when the multinomial table is sparse. For more accurate p-values, you can conduct a Monte-Carlo simulation study (see examples).

Usage

```r
multinomialFit(
  grp,
  independenceGrp,
  ..., 
  method = "lr",
  log = TRUE,
  .twotier = TRUE
)
```

Arguments
- `grp` a list containing the model and data. See the details section.
- `independenceGrp` the independence group
- `...` Not used. Forces remaining arguments to be specified by name.
- `method` lr (default) or pearson
- `log` whether to report p-value in log units
- `.twotier` whether to use the two-tier optimization (default TRUE)

Details
- Rows with missing data are ignored.
- The full information test is described in Bartholomew & Tzamourani (1999, Section 3).
- For CFI and TLI, you must provide an `independenceGrp`.

Format of a group
- A model, or group within a model, is represented as a named list.
  - `spec` list of response model objects
  - `param` numeric matrix of item parameters
  - `free` logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
  - `mean` numeric vector giving the mean of the latent distribution
**cov** numeric matrix giving the covariance of the latent distribution

**data** data.frame containing observed item responses, and optionally, weights and frequencies

**score** factors scores with response patterns in rows

**weightColumn** name of the data column containing the numeric row weights (optional)

**freqColumn** name of the data column containing the integral row frequencies (optional)

**qwidth** width of the quadrature expressed in Z units

**qpoints** number of quadrature points

**minItemsPerScore** minimum number of non-missing items when estimating factor scores

The param matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in spec and order of columns in param are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by param colnames.

Currently only a multivariate normal distribution is available, parameterized by the mean and cov. If mean and cov are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by EAPscores.

**References**


**See Also**

Other diagnostic: *ChenThissen1997*, *SitemFit1*, *SitemFit*, *rpf.1dim.fit*, *sumScoreEAPTest*

**Examples**

```r
# Create an example IFA group
grp <- list(spec=list())
grp$spec[1:10] <- rpf.grm()
grp$param <- sapply(grp$spec, rpf.rparam)
colnames(grp$param) <- paste("i", 1:10, sep="")
grp$mean <- 0
grp$cov <- diag(1)
grp$uniqueFree <- sum(grp$param != 0)
grp$data <- rpf.sample(1000, grp=grp)
# Monte-Carlo simulation study
mcReps <- 3 # increase this to 10,000 or so
stat <- rep(NA, mcReps)
for (rx in 1:mcReps) {
  # ...
}
```

observedSumScore

```r
t1 <- grp
t1$data <- rpf.sample(grp=grp)
stat[rx] <- multinomialFit(t1)$statistic
}
sum(multinomialFit(grp)$statistic > stat)/mcReps # better p-value
```

---

### observedSumScore

*Compute the observed sum-score*

---

#### Description

When `summary=TRUE`, tabulation uses row frequency multiplied by row weight.

#### Usage

```r
observedSumScore(grp, ..., mask, summary = TRUE)
```

#### Arguments

- **grp**: a list containing the model and data. See the details section.
- **...**: Not used. Forces remaining arguments to be specified by name.
- **mask**: a vector of logicals indicating which items to include
- **summary**: whether to return a summary (default) or per-row scores

#### Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores
The `param` matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in `spec` and order of columns in `param` are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by `param` colnames.

Currently only a multivariate normal distribution is available, parameterized by the `mean` and `cov`. If `mean` and `cov` are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, `qwidth=2` and `qpoints=5` would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by `EAPscores`.

See Also

Other scoring: `EAPscores()`, `bestToOmit()`, `itemOutcomeBySumScore()`, `omitItems()`, `omitMostMissing()`, `sumScoreEAP()`

Examples

```r
spec <- list()
spec[1:3] <- rpf.grm(outcomes=3)
param <- sapply(spec, rpf.rparam)
data <- rpf.sample(5, spec, param)
colnames(param) <- colnames(data)
grp <- list(spec=spec, param=param, data=data)
observedSumScore(grp)
```

### omitItems

#### Description

Omit the given items

#### Usage

```r
omitItems(grp, excol)
```

#### Arguments

- `grp`: a list containing the model and data. See the details section.
- `excol`: vector of column names to omit
Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores

The `param` matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in `spec` and order of columns in `param` are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by `param` colnames.

Currently only a multivariate normal distribution is available, parameterized by the `mean` and `cov`. If `mean` and `cov` are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, `qwidth=2` and `qpoints=5` would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by `EAPscores`.

See Also

Other scoring: `EAPscores()`, `bestToOmit()`, `itemOutcomeBySumScore()`, `observedSumScore()`, `omitMostMissing()`, `sumScoreEAP()`

---

**omitMostMissing**

*Omit items with the most missing data*

Description

Items with no missing data are never omitted, regardless of the number of items requested.

Usage

```
omitMostMissing(grp, omit)
```
Arguments

- **grp**: a list containing the model and data. See the details section.
- **omit**: the maximum number of items to omit

Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores

The **param** matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in **spec** and order of columns in **param** are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by **param** colnames.

Currently only a multivariate normal distribution is available, parameterized by the **mean** and **cov**. If **mean** and **cov** are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, **qwidth=2** and **qpoints=5** would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by **EAPscores**.

See Also

Other scoring: **EAPscores()**, **bestToOmit()**, **itemOutcomeBySumScore()**, **observedSumScore()**, **omitItems()**, **sumScoreEAP()**
**orderCompletely**  
Order a data.frame by missingness and all columns

**Description**  
Completely order all rows in a data.frame.

**Usage**  
orderCompletely(observed)

**Arguments**  
observed  
a data.frame holding ordered factors in every column

**Value**  
the sorted order of the rows

**Examples**

df <- as.data.frame(matrix(c(sample.int(2, 30, replace=TRUE)), 10, 3))  
mask <- matrix(c(sample.int(3, 30, replace=TRUE)), 10, 3) == 1  
df[mask] <- NA  
df[orderCompletely(df),]

---

**ordinal.gamma**  
Compute the ordinal gamma association statistic

**Description**  
Compute the ordinal gamma association statistic

**Usage**  
ordinal.gamma(mat)

**Arguments**  
mat  
a cross tabulation matrix

**References**
ptw2011.gof.test

Examples

# Example data from Agresti (1990, p. 21)
jobsat <- matrix(c(20, 22, 13, 7, 24, 38, 28, 18, 80, 104, 81, 54, 82, 125, 113, 92), nrow=4, ncol=4)
ordinal.gamma(jobsat)

ptw2011.gof.test Compute the P value that the observed and expected tables come from
the same distribution

Description

[Experimental] This test is an alternative to Pearson’s X^2 goodness-of-fit test. In contrast to
Pearson’s X^2, no ad hoc cell collapsing is needed to avoid an inflated false positive rate in situations
of sparse cell frequencies. The statistic rapidly converges to the Monte-Carlo estimate as the number
of draws increases.

Usage

ptw2011.gof.test( observed, expected)

Arguments

observed observed matrix
expected expected matrix

Value

The P value indicating whether the two tables come from the same distribution. For example, a
significant result (P < alpha level) rejects the hypothesis that the two matrices are from the same
distribution.

References

Perkins, W., Tygert, M., & Ward, R. (2011). Computing the confidence levels for a root-mean-
square test of goodness-of-fit. Applied Mathematics and Computations, 217(22), 9072-9084.

Examples

draws <- 17
observed <- matrix(c(.294, .176, .118, .411), nrow=2) * draws
expected <- matrix(c(.235, .235, .176, .353), nrow=2) * draws
ptw2011.gof.test( observed, expected) # not significant
Description

[Experimental] This was last updated in 2017 and may no longer work.

Usage

read.flexmirt(fname)

Arguments

fname file name

Details

Load the item parameters from a flexMIRT PRM file.

Value

a list of groups as described in the details

Format of a group

A model, or group within a model, is represented as a named list.

spec list of response model objects

param numeric matrix of item parameters

free logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)

mean numeric vector giving the mean of the latent distribution

cov numeric matrix giving the covariance of the latent distribution

data data.frame containing observed item responses, and optionally, weights and frequencies

score factors scores with response patterns in rows

weightColumn name of the data column containing the numeric row weights (optional)

dataColumn name of the data column containing the integral row frequencies (optional)

qwidth width of the quadrature expressed in Z units

qpoints number of quadrature points

minItemsPerScore minimum number of non-missing items when estimating factor scores

The param matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in spec and order of columns in param are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by param colnames.
Currently only a multivariate normal distribution is available, parameterized by the mean and cov. If mean and cov are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by EAPscores.

rpf.1dim.fit

Calculate item and person Rasch fit statistics

Description

Note: These statistics are only appropriate if all discrimination parameters are fixed equal and items are conditionally independent (see ChenThissen1997). A best effort is made to cope with missing data.

Usage

rpf.1dim.fit(
  spec,
  params,
  responses,
  scores,
  margin,
  group = NULL,
  wh.exact = TRUE
)

Arguments

spec list of item response models [Deprecated]
params matrix of item parameters, 1 per column [Deprecated]
responses persons in rows and items in columns [Deprecated]
scores model derived person scores [Deprecated]
margin for people 1, for items 2
 group spec, params, data, and scores can be provided in a list instead of as arguments
wh.exact whether to use the exact Wilson-Hilferty transformation

Details

Exact distributional properties of these statistics are unknown (Masters & Wright, 1997, p. 112). For details on the calculation, refer to Wright & Masters (1982, p. 100).

The Wilson-Hilferty transformation is biased for less than 25 items. Consider wh.exact=FALSE for less than 25 items.
Format of a group

A model, or group within a model, is represented as a named list.

**spec**  list of response model objects

**param**  numeric matrix of item parameters

**free**  logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)

**mean**  numeric vector giving the mean of the latent distribution

**cov**  numeric matrix giving the covariance of the latent distribution

**data**  data.frame containing observed item responses, and optionally, weights and frequencies

**score**  factors scores with response patterns in rows

**weightColumn**  name of the data column containing the numeric row weights (optional)

**freqColumn**  name of the data column containing the integral row frequencies (optional)

**qwidth**  width of the quadrature expressed in Z units

**qpoints**  number of quadrature points

**minItemsPerScore**  minimum number of non-missing items when estimating factor scores

The **param** matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in **spec** and order of columns in **param** are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by **param** colnames.

Currently only a multivariate normal distribution is available, parameterized by the **mean** and **cov**. If **mean** and **cov** are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, **qwidth=2** and **qpoints=5** would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by **EAPscores**.

A model, or group within a model, is represented as a named list.

**spec**  list of response model objects

**param**  numeric matrix of item parameters

**free**  logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)

**mean**  numeric vector giving the mean of the latent distribution

**cov**  numeric matrix giving the covariance of the latent distribution

**data**  data.frame containing observed item responses, and optionally, weights and frequencies

**score**  factors scores with response patterns in rows

**weightColumn**  name of the data column containing the numeric row weights (optional)

**freqColumn**  name of the data column containing the integral row frequencies (optional)

**qwidth**  width of the quadrature expressed in Z units

**qpoints**  number of quadrature points

**minItemsPerScore**  minimum number of non-missing items when estimating factor scores
The `param` matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in `spec` and order of columns in `param` are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting `rownames`. Item names are assigned by `param` `colnames`.

Currently only a multivariate normal distribution is available, parameterized by the `mean` and `cov`. If `mean` and `cov` are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, `qwidth=2` and `qpoints=5` would produce points `-2, -1, 0, 1, and 2`. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by `EAPscores`.

### References


### See Also

Other diagnostic: `ChenThissen1997()`, `SitemFit1()`, `SitemFit()`, `multinomialFit()`, `sumScoreEAPTest()`

### Examples

```r
data(kct)
responses <- kct.people[,paste("V",2:19, sep="")] 
rownames(responses) <- kct.people$NAME 
colnames(responses) <- kct.items$NAME 
scores <- kct.people$MEASURE 
params <- cbind(1, kct.items$MEASURE, logit(0), logit(1)) 
rownames(params) <- kct.items$NAME 
items<-list()
items[1:18] <- rpf.drm()
params[,2] <- -params[,2]
rpf.1dim.fit(items, t(params), responses, scores, 2, wh.exact=TRUE)
```

---

**rpfl1mom.moment**

*Calculate cell central moments*

#### Description

Popular central moments include 2 (variance) and 4 (kurtosis).

#### Usage

```r
rpfl1mom.moment(spec, params, scores, m)
```
**Arguments**

- **spec**
  - list of item models
- **params**
  - data frame of item parameters, 1 per row
- **scores**
  - model derived person scores
- **m**
  - which moment

**Value**

- moment matrix

---

*rpf.1dim.residual*  
*Calculate residuals*

**Description**

Calculate residuals

**Usage**

*rpf.1dim.residual(spec, params, responses, scores)*

**Arguments**

- **spec**
  - list of item models
- **params**
  - data frame of item parameters, 1 per row
- **responses**
  - persons in rows and items in columns
- **scores**
  - model derived person scores

**Value**

residuals
rpf.1dim.stdresidual  Calculate standardized residuals

Description
Calculate standardized residuals

Usage
rpf.1dim.stdresidual(spec, params, responses, scores)

Arguments
spec  list of item models
params data frame of item parameters, 1 per row
responses persons in rows and items in columns
scores model derived person scores

Value
standardized residuals

rpf.dLL  Item parameter derivatives

Description
Evaluate the partial derivatives of the log likelihood with respect to each parameter at where with weight.

Usage
rpf.dLL(m, param, where, weight)

Arguments
m  item model
param  item parameters
where location in the latent space
weight  per outcome weights (typically derived by observation)
Details

It is not easy to write an example for this function. To evaluate the derivative, you need to sum the
derivatives across a quadrature. You also need response outcome weights at each quadrature point.
It is not anticipated that this function will be often used in R code. It’s mainly to expose a C-level
function for occasional debugging.

Value

first and second order partial derivatives of the log likelihood evaluated at where. For p parameters,
the first p values are the first derivative and the next p(p+1)/2 columns are the lower triangle of the
second derivative.

See Also

The numDeriv package.

---

**rpf.drm**  
Create a dichotomous response model

Description

For slope vector a, intercept c, pseudo-guessing parameter g, upper bound u, and latent ability vector
theta, the response probability function is

\[
P(\text{pick} = 0|a, c, g, u, \theta) = 1 - P(\text{pick} = 1|a, c, g, u, \theta)
\]

\[
P(\text{pick} = 1|a, c, g, u, \theta) = g + (u - g) \frac{1}{1 + \exp(-(a\theta + c))}
\]

Usage

rpf.drm(factors = 1, multidimensional = TRUE, poor = FALSE)

Arguments

- **factors**: the number of factors
- **multidimensional**: whether to use a multidimensional model. Defaults to `TRUE`.
- **poor**: if `TRUE`, use the traditional parameterization of the 1d model instead of the
  slope-intercept parameterization

Details

The pseudo-guessing and upper bound parameter are specified in logit units (see `logit`).
For discussion on the choice of priors see Cai, Yang, and Hansen (2011, p. 246).
Value

an item model

References


See Also

Other response model: `rpf.gpcmp()`, `rpf.grmp()`, `rpf.grm()`, `rpf.lmp()`, `rpf.mcm()`, `rpf.nrm()`

Examples

```r
spec <- rpf.drm()
rpf.prob(spec, rpf.rparam(spec), 0)
```

---

**rpf.dTheta**

*Item derivatives with respect to the location in the latent space*

Description

Evaluate the partial derivatives of the response probability with respect to ability. See `rpf.info` for an application.

Usage

```r
rpf.dTheta(m, param, where, dir)
```

Arguments

- `m` : item model
- `param` : item parameters
- `where` : location in the latent distribution
- `dir` : if more than 1 factor, a basis vector
Description

This model is a polytomous model proposed by Falk & Cai (2016) and is based on the generalized partial credit model (Muraki, 1992).

Usage

```r
rpf.gpcmp(outcomes = 2, q = 0, multidimensional = FALSE)
```

Arguments

- **outcomes**: The number of possible response categories.
- **q**: a non-negative integer that controls the order of the polynomial (2q+1) with a default of q=0 (1st order polynomial = generalized partial credit model).
- **multidimensional**: whether to use a multidimensional model. Defaults to FALSE. The multidimensional version is not yet available.

Details

The GPC-MP replaces the linear predictor part of the generalized partial credit model with a monotonic polynomial, \( m(\theta; \omega, \xi, \alpha, \tau) \). The response function for category k is:

\[
P(pick = k | \omega, \xi, \alpha, \tau, \theta) = \frac{\exp(\sum_{v=0}^{k} (\xi_k + m(\theta; \omega, \xi, \alpha, \tau)))}{\sum_{u=0}^{K-1} \exp(\sum_{v=0}^{u} (\xi_u + m(\theta; \omega, \xi, \alpha, \tau)))}
\]

where \( \alpha \) and \( \tau \) are vectors of length \( q \). The GPC-MP uses the same parameterization for the polynomial as described for the logistic function of a monotonic polynomial (LMP). See also \( \text{rpf.lmp} \).

The order of the polynomial is always odd and is controlled by the user specified non-negative integer, \( q \). The model contains 1+(outcomes-1)+2*q parameters and are used as input to the \( \text{rpf.prob} \) function in the following order: \( \omega \) - natural log of the slope of the item model when \( q=0 \), \( \xi \) - a (outcomes-1)-length vector of intercept parameters, \( \alpha \) and \( \tau \) - two parameters that control bends in the polynomial. These latter parameters are repeated in the same order for models with \( q>0 \). For example, a \( q=2 \) polynomial with 3 categories will have an item parameter vector of: \( \omega, \xi_1, \xi_2, \alpha_1, \alpha_2, \tau_1, \tau_2 \).

Note that the GPC-MP reduces to the LMP when the number of categories is 2, and the GPC-MP reduces to the generalized partial credit model when the order of the polynomial is 1 (i.e., \( q=0 \)).

Value

an item model
References


See Also

Other response model: `rpf.drm()`, `rpf.grmp()`, `rpf.grm()`, `rpf.lmp()`, `rpf.mcm()`, `rpf.nrm()`

Examples

```r
spec <- rpf.grm(5,2) # 5-category, 3rd order polynomial
theta <- seq(-3,3,.1)
p <- rpf.prob(spec, c(1.02,3.48,2.5,-.25,-1.64,.89,-8.7,-.74,-8.99),theta)
```

---

**rpf.grm**

*Create a graded response model*

**Description**

For outcomes k in 0 to K, slope vector a, intercept vector c, and latent ability vector theta, the response probability function is

\[
P(\text{pick} = 0|a, c, \theta) = 1 - P(\text{pick} = 1|a, c_1, \theta)
\]

\[
P(\text{pick} = k|a, c, \theta) = \frac{1}{1 + \exp(-(a\theta + c_k))} - \frac{1}{1 + \exp(-(a\theta + c_{k+1}))}
\]

\[
P(\text{pick} = K|a, c, \theta) = \frac{1}{1 + \exp(-(a\theta + c_K))}
\]

**Usage**

`rpf.grm(outcomes = 2, factors = 1, multidimensional = TRUE)`

**Arguments**

- `outcomes` The number of choices available
- `factors` the number of factors
- `multidimensional` whether to use a multidimensional model. Defaults to TRUE.
The graded response model was designed for an item with a series of dependent parts where a higher score implies that easier parts of the item were surmounted. If there is any chance your polytomous item has independent parts then consider `rpf.nrm`. If your categories cannot cross then the graded response model provides a little more information than the nominal model. Stronger a priori assumptions offer provide more power at the cost of flexibility.

Value

an item model

See Also

Other response model: `rpf.drm()`, `rpf.gpcmp()`, `rpf.grmp()`, `rpf.lmp()`, `rpf.mcm()`, `rpf.nrm()`

Examples

```r
spec <- rpf.grm()
rpf.prob(spec, rpf.rparam(spec), 0)
```

---

### Description

The GR-MP model replaces the linear predictor of the graded response model (Samejima, 1969, 1972) with a monotonic polynomial (Falk, conditionally accepted).

### Usage

```r
rpf.grmp(outcomes = 2, q = 0, multidimensional = FALSE)
```

### Arguments

- **outcomes**: The number of possible response categories. When equal to 2, the model reduces to the logistic function of a monotonic polynomial (LMP).
- **q**: a non-negative integer that controls the order of the polynomial (2q+1) with a default of q=0 (1st order polynomial = graded response model).
- **multidimensional**: whether to use a multidimensional model. Defaults to FALSE. The multidimensional version is not yet available.
Details

Given its relationship to the graded response model, the GR-MP is constructed in an analogous way:

\[ P(\text{pick} = 0 | \lambda, \alpha, \tau, \theta) = 1 - \frac{1}{1 + \exp(-(\xi_1 + m(\theta; \lambda, \alpha, \tau)))} \]

\[ P(\text{pick} = k | \lambda, \alpha, \tau, \theta) = \frac{1}{1 + \exp(-(\xi_k + m(\theta; \lambda, \alpha, \tau)))} - \frac{1}{1 + \exp(-(\xi_{k+1} + m(\theta; \lambda, \alpha, \tau)))} \]

\[ P(\text{pick} = K | \lambda, \alpha, \tau, \theta) = \frac{1}{1 + \exp(-(\xi_K + m(\theta; \lambda, \alpha, \tau)))} \]

The order of the polynomial is always odd and is controlled by the user specified non-negative integer, q. The model contains \(1 + \text{outcomes}-1 + 2\times q\) parameters and are used as input to the \texttt{rpf.prob} or \texttt{rpf.dTheta} functions in the following order: \(\lambda\) - slope of the item model when \(q=0\), \(\xi\) - a \((\text{outcomes}-1)\)-length vector of intercept parameters, \(\alpha\) and \(\tau\) - two parameters that control bends in the polynomial. These latter parameters are repeated in the same order for models with \(q>0\). For example, a \(q=2\) polynomial with 3 categories will have an item parameter vector of: \(\lambda, \xi_1, \xi_2, \alpha_1, \tau_1, \alpha_2, \tau_2\).

As with other monotonic polynomial-based item models (e.g., \texttt{rpf.lmp}), the polynomial looks like the following:

\[ m(\theta; \lambda, \alpha, \tau) = b_1 \theta + b_2 \theta^2 + \cdots + b_{2q+1} \theta^{2q+1} \]

However, the coefficients, \(b\), are not directly estimated, but are a function of the item parameters, and the parameterization of the GR-MP is different than that currently appearing for the logistic function of a monotonic polynomial (LMP; \texttt{rpf.lmp}) and monotonic polynomial generalized partial credit (GPC-MP; \texttt{rpf.gpcmp}) models. In particular, the polynomial is parameterized such that boundary discrimination functions for the GR-MP will be all monotonically increasing or decreasing for any given item. This allows the possibility of items that load either negatively or positively on the latent trait, as is common with reverse-worded items in non-cognitive tests (e.g., personality).

The derivative \(m'(\theta; \lambda, \alpha, \tau)\) is parameterized in the following way:

\[ m'(\theta; \lambda, \alpha, \tau) = \begin{cases} 
\lambda \prod_{u=1}^{q} (1 - 2\alpha_u \theta + (\alpha_u^2 + \exp(\tau_u))\theta^2) & \text{if } q > 0 \\
\lambda & \text{if } q = 0
\end{cases} \]

Note that the only difference between the GR-MP and these other models is that \(\lambda\) is not re-parameterized and may take on negative values. When \(\lambda\) is negative, it is analogous to having a negative loading or a monotonically decreasing function.

Value

an item model
rpf.id_of

References


See Also

Other response model: `rpf.drm()`, `rpf.gpcmp()`, `rpf.grm()`, `rpf.lmp()`, `rpf.mcm()`, `rpf.nrm()`

Examples

```r
spec <- rpf.grmp(5,2) # 5-category, 3rd order polynomial
theta <- seq(-3,3,.1)
p <- rpf.prob(spec, c(2.77,2,1,0,-1,.89,-8.7,-.74,-8.99), theta)
```

---

**rpf.id_of**

*Convert an rpf item model name to an ID*

**Description**

This is an internal function and should not be used.

**Usage**

`rpf.id_of(name)`

**Arguments**

name  
name of the item model (string)

**Value**

the integer ID assigned to the given model
### rpf.info

Map an item model, item parameters, and person trait score into a information vector

**Description**

Map an item model, item parameters, and person trait score into a information vector

**Usage**

rpf.info(ii, ii.p, where, basis = 1)

**Arguments**

- ii: an item model
- ii.p: item parameters
- where: the location in the latent distribution
- basis: if more than 1 factor, a positive basis vector

**Value**

Fisher information

**References**


**Examples**

```r
i1 <- rpf.drm()
i1.p <- c(.6,1,.1,.95)
theta <- seq(0,3,.05)
plot(theta, rpf.info(i1, i1.p, t(theta)), type="l")
```

### rpf.lmp

Create logistic function of a monotonic polynomial (LMP) model

**Description**

This model is a dichotomous response model originally proposed by Liang (2007) and is implemented using the parameterization by Falk & Cai (2016).

**Usage**

rpf.lmp(q = 0, multidimensional = FALSE)
Arguments

q

a non-negative integer that controls the order of the polynomial \((2q+1)\) with a default of \(q=0\) (1st order polynomial = 2PL).

multidimensional

whether to use a multidimensional model. Defaults to \texttt{FALSE}. The multidimensional version is not yet available.

Details

The LMP model replaces the linear predictor part of the two-parameter logistic function with a monotonic polynomial, \(m(\theta, \omega, \xi, \alpha, \tau)\),

\[
P(\text{pick } = 1|\omega, \xi, \alpha, \tau, \theta) = \frac{1}{1 + \exp(-(\xi + m(\theta; \omega, \alpha, \tau)))}
\]

where \(\alpha\) and \(\tau\) are vectors of length \(q\).

The order of the polynomial is always odd and is controlled by the user specified non-negative integer, \(q\). The model contains \(2+2q\) parameters and are used in conjunction with the \texttt{rpf.prob} or \texttt{rpf.dTheta} function in the following order: \(\omega\) - the natural log of the slope of the item model when \(q=0\), \(\xi\) - the intercept, \(\alpha\) and \(\tau\) - two parameters that control bends in the polynomial. These latter parameters are repeated in the same order for models with \(q>0\). For example, a \(q=2\) polynomial with have an item parameter vector of: \(\omega, \xi, \alpha_1, \tau_1, \alpha_2, \tau_2\).

In general, the polynomial looks like the following:

\[
m(\theta; \omega, \alpha, \tau) = b_1 \theta + b_2 \theta^2 + \cdots + b_{2q+1} \theta^{2q+1}
\]

However, the coefficients, \(b\), are not directly estimated, but are a function of the item parameters. In particular, the derivative \(m'(\theta; \omega, \alpha, \tau)\) is parameterized in the following way:

\[
m'(\theta; \omega, \alpha, \tau) = \begin{cases} 
\exp(\omega) \prod_{u=1}^{q}(1 - 2\alpha_u \theta + (\alpha_u^2 + \exp(\tau_u))\theta^2) & \text{if } q > 0 \\
\exp(\omega) & \text{if } q = 0
\end{cases}
\]

See Falk & Cai (2016) for more details as to how the polynomial is constructed. At the lowest order polynomial (\(q=0\)) the model reduces to the two-parameter logistic (2PL) model. However, parameterization of the slope parameter, \(\omega\), is currently different than the 2PL (i.e., slope = \exp(\omega)). This parameterization ensures that the response function is always monotonically increasing without requiring constrained optimization.

For an alternative parameterization that releases constraints on \(\omega\), allowing for monotonically decreasing functions, see \texttt{rpf.grmp}. And for polytomous items, see both \texttt{rpf.grmp} and \texttt{rpf.gpcmp}.

Value

an item model
rpf.logprob

Map an item model, item parameters, and person trait score into a probability vector

Description

Note that in general, exp(rpf.logprob(..)) != rpf.prob(..) because the range of logits is much wider than the range of probabilities due to limitations of floating point numerical precision.

Usage

rpf.logprob(m, param, theta)

Arguments

m an item model
param item parameters
theta the trait score(s)

Value

a vector of probabilities. For dichotomous items, probabilities are returned in the order incorrect, correct. Although redundant, both incorrect and correct probabilities are returned in the dichotomous case for API consistency with polytomous item models.

References


See Also

Other response model: rpf.drm(), rpf.gpcmp(), rpf.grmp(), rpf.grm(), rpf.mcm(), rpf.nrm()

Examples

```r
spec <- rpf.lmp(1) # 3rd order polynomial
theta <- seq(-3,3,.1)
p <- rpf.prob(spec, c(-.11,.37,.24,-.21),theta)

spec <- rpf.lmp(2) # 5th order polynomial
p <- rpf.prob(spec, c(.69,.71,-.5,-8.48,.52,-3.32),theta)
```

```r
rpf.logprob

Map an item model, item parameters, and person trait score into a probability vector

Usage

rpf.logprob(m, param, theta)

Arguments

m an item model
param item parameters
theta the trait score(s)

Value

a vector of probabilities. For dichotomous items, probabilities are returned in the order incorrect, correct. Although redundant, both incorrect and correct probabilities are returned in the dichotomous case for API consistency with polytomous item models.

References


See Also

Other response model: rpf.drm(), rpf.gpcmp(), rpf.grmp(), rpf.grm(), rpf.mcm(), rpf.nrm()

Examples

```r
spec <- rpf.lmp(1) # 3rd order polynomial
theta <- seq(-3,3,.1)
p <- rpf.prob(spec, c(-.11,.37,.24,-.21),theta)

spec <- rpf.lmp(2) # 5th order polynomial
p <- rpf.prob(spec, c(.69,.71,-.5,-8.48,.52,-3.32),theta)
```
\texttt{rpf.mcm}

\textbf{Examples}

\begin{verbatim}
  i1 <- rpf.drm()
  i1.p <- rpf.rparam(i1)
  rpf.logprob(i1, c(i1.p), -1)  # low trait score
  rpf.logprob(i1, c(i1.p), c(0,1))  # average and high trait score
\end{verbatim}

\textbf{rpf.mcm} \hspace{1cm} \textit{Create a multiple-choice response model}

\textbf{Description}

[Experimental]

\textbf{Usage}

\begin{verbatim}
  rpf.mcm(outcomes = 2, numChoices = 5, factors = 1)
\end{verbatim}

\textbf{Arguments}

\begin{verbatim}
  outcomes \hspace{1cm} the number of possible outcomes
  numChoices \hspace{1cm} the number of choices available
  factors \hspace{1cm} the number of factors
\end{verbatim}

\textbf{Details}

This function instantiates a multiple-choice response model.

\textbf{Value}

an item model

\textbf{Author(s)}

Jonathan Weeks <weeksjp@gmail.com>

\textbf{See Also}

Other response model: \texttt{rpf.drm()}, \texttt{rpf.gpcmp()}, \texttt{rpf.grmp()}, \texttt{rpf.grm()}, \texttt{rpf.lmp()}, \texttt{rpf.nrm()}
**rpf.mean.info**  
*Find the point where an item provides mean maximum information*

**Description**

[Experimental] This is a point estimate of the mean difficulty of items that do not offer easily interpretable parameters such as the Generalized PCM. Since the information curve may not be unimodal, this function integrates across the latent space.

**Usage**

```r
rpf.mean.info(spec, param, grain = 0.1)
```

**Arguments**

- `spec` list of item specs
- `param` list or matrix of item parameters
- `grain` the step size for numerical integration (optional)

---

**rpf.mean.info1**  
*Find the point where an item provides mean maximum information*

**Description**

[Experimental]

**Usage**

```r
rpf.mean.info1(spec, iparam, grain = 0.1)
```

**Arguments**

- `spec` an item spec
- `iparam` an item parameter vector
- `grain` the step size for numerical integration (optional)
**rpf.modify**

*Create a similar item specification with the given number of factors*

**Description**

Create a similar item specification with the given number of factors

**Usage**

```r
rpf.modify(m, factors)
```

**Arguments**

- `m` : item model
- `factors` : the number of factors/dimensions

**Examples**

```r
s1 <- rpf.grm(factors=3)
rpf.rparam(s1)
s2 <- rpf.modify(s1, 1)
rpf.rparam(s2)
```

---

**rpf.nrm**

*Create a nominal response model*

**Description**

This function instantiates a nominal response model.

**Usage**

```r
rpf.nrm(outcomes = 3, factors = 1, T.a = "trend", T.c = "trend")
```

**Arguments**

- `outcomes` : The number of choices available
- `factors` : the number of factors
- `T.a` : the T matrix for slope parameters
- `T.c` : the T matrix for intercept parameters
Details

The transformation matrices $T_a$ and $T_c$ are chosen by the analyst and not estimated. The $T$ matrices must be invertible square matrices of size outcomes-1. As a shortcut, either $T$ matrix can be specified as "trend" for a Fourier basis or as "id" for an identity basis. The response probability function is

$$a = T_a \alpha$$

$$c = T_c \gamma$$

$$P(\text{pick } = k | s, a_k, c_k, \theta) = C \frac{1}{1 + \exp(-s(\theta a_k + c_k))}$$

where $a_k$ and $c_k$ are the result of multiplying two vectors of free parameters $\alpha$ and $\gamma$ by fixed matrices $T_a$ and $T_c$, respectively; $a_0$ and $c_0$ are fixed to 0 for identification; and $C$ is a normalizing factor to ensure that $\sum_k P(\text{pick } = k) = 1$.

Value

an item model

References


See Also

Other response model: rpf.drm(), rpf.gpcmp(), rpf.grmp(), rpf.grm(), rpf.lmp(), rpf.mcm()

Examples

```r
spec <- rpf.nrm()
rpf.prob(spec, rpf.rparam(spec), 0)
# typical parameterization for the Generalized Partial Credit Model
gpcm <- function(outcomes) rpf.nrm(outcomes, T.c=lower.tri(diag(outcomes-1),TRUE) * -1)
spec <- gpcm(4)
rpf.prob(spec, rpf.rparam(spec), 0)
```
**rpf.numParam**

**Length of the item parameter vector**

**Description**

Length of the item parameter vector

**Usage**

```r
rpf.numParam(m)
```

**Arguments**

- `m` item model

**Examples**

```r
rpf.numParam(rpf.grm(outcomes=3))
rpf.numParam(rpf.nrm(outcomes=3))
```

---

**rpf.numSpec**

**Length of the item model vector**

**Description**

Length of the item model vector

**Usage**

```r
rpf.numSpec(m)
```

**Arguments**

- `m` item model

**Examples**

```r
rpf.numSpec(rpf.grm(outcomes=3))
rpf.numSpec(rpf.nrm(outcomes=3))
```
The ogive constant can be multiplied by the discrimination parameter to obtain a response curve very similar to the Normal cumulative distribution function (Haley, 1952; Molenaar, 1974). Recently, Savalei (2006) proposed a new constant of 1.749 based on Kullback-Leibler information.

Usage

\texttt{rpf.ogive}

Format

An object of class \texttt{numeric} of length 1.

Details

In recent years, the logistic has grown in favor, and therefore, this package does not offer any special support for this transformation (Baker & Kim, 2004, pp. 14-18).

References


**rpf.paramInfo**

Retrieve a description of the given parameter

Description

Retrieve a description of the given parameter

Usage

```r
rpf.paramInfo(m, num = NULL)
```

Arguments

- `m`: item model
- `num`: vector of parameters (defaults to all)

Value

a list containing the type, upper bound, and lower bound

Examples

```r
rpf.paramInfo(rpf.drm())
```

---

**rpf.prob**

Map an item model, item parameters, and person trait score into a probability vector

Description

This function is known by many names in the literature. When plotted against latent trait, it is often called a traceline, item characteristic curve, or item response function. Sometimes the word 'category' or 'outcome' is used in place of 'item'. For example, 'item response function' might become 'category response function'. All these terms refer to the same thing.

Usage

```r
rpf.prob(m, param, theta)
```

Arguments

- `m`: an item model
- `param`: item parameters
- `theta`: the trait score(s)
Value

A vector of probabilities. For dichotomous items, probabilities are returned in the order incorrect, correct. Although redundant, both incorrect and correct probabilities are returned in the dichotomous case for API consistency with polytomous item models.

Examples

```r
il <- rpf.drm()
il.p <- rpf.rparam(il)
rpf.prob(il, c(il.p), -1)  # low trait score
rpf.prob(il, c(il.p), c(0,1))  # average and high trait score
```

---

**rpf.rescale**  
*Rescale item parameters*

Description

Adjust item parameters for changes in mean and covariance of the latent distribution.

Usage

```r
rpf.rescale(m, param, mean, cov)
```

Arguments

- `m`: item model
- `param`: item parameters
- `mean`: vector of means
- `cov`: covariance matrix

Examples

```r
spec <- rpf.grm()
p1 <- rpf.rparam(spec)
testPoint <- rnorm(1)
move <- rnorm(1)
cov <- as.matrix(rlnorm(1))
Icov <- solve(cov)
padj <- rpf.rescale(spec, p1, move, cov)
pr1 <- rpf.prob(spec, padj, (testPoint-move) %*% Icov)
pr2 <- rpf.prob(spec, p1, testPoint)
abs(pr1 - pr2) < 1e9
```
rpf.rparam  

Generates item parameters

Description

This function generates random item parameters. The version argument is available if you are writing a test that depends on reproducible random parameters (using set.seed).

Usage

rpf.rparam(m, version = 2L)

Arguments

- m: an item model
- version: the version of random parameters

Value

item parameters

Examples

```r
i1 <- rpf.drm()
rpf.rparam(i1)
```

rpf.sample  

Randomly sample response patterns given a list of items

Description

Returns a random sample of response patterns given a list of item models and parameters. If grp is given then theta, items, params, mean, and cov can be omitted.

Usage

```r
rpf.sample(
  theta,
  items,
  params,
  ...
  prefix = "i",
  mean = NULL,
  cov = NULL,
  mcar = 0,
  grp = NULL
)
```
Arguments

theta either a vector (for 1 dimension) or a matrix (for >1 dimension) of person abilities or the number of response patterns to generate randomly
items a list of item models
params a list or matrix of item parameters. If omitted, random item parameters are generated for each item model.
... Not used. Forces remaining arguments to be specified by name.
prefix Column names are taken from param or items. If no column names are available, some will be generated using the given prefix.
mean mean vector of latent distribution (optional)
cov covariance matrix of latent distribution (optional)
mcar proportion of generated data to set to NA (missing completely at random)
grp a list containing the model and data. See the details section.

Value

Returns a data frame of response patterns

Format of a group

A model, or group within a model, is represented as a named list.

spec list of response model objects
param numeric matrix of item parameters
free logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
mean numeric vector giving the mean of the latent distribution
cov numeric matrix giving the covariance of the latent distribution
data data.frame containing observed item responses, and optionally, weights and frequencies
score factors scores with response patterns in rows
weightColumn name of the data column containing the numeric row weights (optional)
freqColumn name of the data column containing the integral row frequencies (optional)
qwidth width of the quadrature expressed in Z units
qpoints number of quadrature points
minItemsPerScore minimum number of non-missing items when estimating factor scores

The param matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in spec and order of columns in param are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by param colnames.

Currently only a multivariate normal distribution is available, parameterized by the mean and cov. If mean and cov are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by EAPscores.
See Also

sample

Examples

# 1 dimensional items
i1 <- rpf.drm()
i1.p <- rpf.rparam(i1)
i2 <- rpf.nrm(outcomes=3)
i2.p <- rpf.rparam(i2)
rpf.sample(5, list(i1,i2), list(i1.p, i2.p))

Description

These data are from Wright & Masters (1982, p. 18).

Details

All items were fit to a 3 category Partial Credit Model (PCM) using Ministep 3.75.0.

References


Examples

data(science)

SitemFit

Compute the S fit statistic for a set of items

Description

Runs SitemFit1 for every item and accumulates the results.
Usage

SitemFit(
  grp,
  ..., 
  method = "pearson",
  log = TRUE,
  qwidth = 6,
  qpoints = 49L,
  alt = FALSE,
  omit = 0L,
  .twotier = TRUE,
  .parallel = TRUE
)

Arguments

  grp              a list containing the model and data. See the details section.
  ...              Not used. Forces remaining arguments to be specified by name.
  method           whether to use a pearson or rms test
  log              whether to return p-values in log units
  qwidth           [Deprecated]
  qpoints          [Deprecated]
  alt              whether to include the item of interest in the denominator
  omit             number of items to omit (a single number) or a list of the length the number of items
  .twotier         whether to enable the two-tier optimization
  .parallel        whether to take advantage of multiple CPUs (default TRUE)

Value

  a list of output from SitemFit1

Format of a group

A model, or group within a model, is represented as a named list.

  spec             list of response model objects
  param            numeric matrix of item parameters
  free             logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
  mean             numeric vector giving the mean of the latent distribution
  cov              numeric matrix giving the covariance of the latent distribution
  data             data.frame containing observed item responses, and optionally, weights and frequencies
  score            factors scores with response patterns in rows
  weightColumn     name of the data column containing the numeric row weights (optional)
freqColumn  name of the data column containing the integral row frequencies (optional)
qwidth  width of the quadrature expressed in Z units
qpoints  number of quadrature points
minItemsPerScore  minimum number of non-missing items when estimating factor scores

The param matrix stores items parameters by column. If a column has more rows than are required
to fully specify a model then the extra rows are ignored. The order of the items in spec and order
of columns in param are assumed to match. All items should have the same number of latent
dimensions. Loadings on latent dimensions are given in the first few rows and can be named by
setting rownames. Item names are assigned by param colnames.

Currently only a multivariate normal distribution is available, parameterized by the mean and cov.
If mean and cov are not specified then a standard normal distribution is assumed. The quadrature
consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2,
-1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments
for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent
distribution parameters. By default, the exact same EAP scores should be produced by EAPscores.

See Also
Other diagnostic: ChenThissen1997(), SitemFit1(), multinomialFit(), rpf.1dim.fit(), sumScoreEAPTest()

Examples
grp <- list(spec=list())
grp$spec[1:20] <- list(rpf.grm())
grp$param <- sapply(grp$spec, rpf.rparam)
colnames(grp$param) <- paste("i", 1:20, sep="")
grp$mean <- 0
grp$cov <- diag(1)
grp$free <- grp$param != 0
grp$data <- rpf.sample(500, grp=grp)
SitemFit(grp)

SitemFit1  Compute the S fit statistic for 1 item

Description
Implements the Kang & Chen (2007) polytomous extension to S statistic of Orlando & Thissen
(2000). Rows with missing data are ignored, but see the omit option.

Usage
SitemFit1(
grp,
item,
free = 0,
...,
    method = "pearson",
    log = TRUE,
    qwidth = 6,
    qpoints = 49L,
    alt = FALSE,
    omit = 0L,
    .twotier = TRUE
  )

Arguments

  grp         a list containing the model and data. See the details section.
  item        the item of interest
  free        the number of free parameters involved in estimating the item (to adjust the df)
  ...         Not used. Forces remaining arguments to be specified by name.
  method      whether to use a pearson or rms test
  log         whether to return p-values in log units
  qwidth      [Deprecated]
  qpoints     [Deprecated]
  alt         whether to include the item of interest in the denominator
  omit        number of items to omit or a character vector with the names of the items to
              omit when calculating the observed and expected sum-score tables
  .twotier    whether to enable the two-tier optimization

Details

  This statistic is good at finding a small number of misfitting items among a large number of well
  fitting items. However, be aware that misfitting items can cause other items to misfit.

  Observed tables cannot be computed when data is missing. Therefore, you can optionally omit
  items with the greatest number of responses missing relative to the item of interest.

  Pearson is slightly more powerful than RMS in most cases I examined.

  Setting alt to TRUE causes the tables to match published articles. However, the default setting of
  FALSE probably provides slightly more power when there are less than 10 items.

  The name of the test, "S", probably stands for sum-score.

Format of a group

  A model, or group within a model, is represented as a named list.

    spec  list of response model objects
    param numeric matrix of item parameters
    free  logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
    mean  numeric vector giving the mean of the latent distribution
stripData

Description

In addition, the freqColumn and weightColumn are reset to NULL.

Usage

stripData(grp)

Arguments

grp a list containing the model and data. See the details section.
Value

The same group without associated data.

Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores

The `param` matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in `spec` and order of columns in `param` are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by `param` colnames.

Currently only a multivariate normal distribution is available, parameterized by the `mean` and `cov`. If `mean` and `cov` are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, `qwidth=2` and `qpoints=5` would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by `EAPscores`.

Examples

```r
spec <- list()
spec[1:3] <- list(rpf.grm(outcomes=3))
param <- sapply(spec, rpf.rparam)
data <- rpf.sample(5, spec, param)
colnames(param) <- colnames(data)
grp <- list(spec=spec, param=param, data=data, minItemsPerScore=1L)
grp$score <- EAPscores(grp)
str(grp)
grp <- stripData(grp)
str(grp)
```
sumScoreEAP (Compute the sum-score EAP table)

Description

Observed tables cannot be computed when data is missing. Therefore, you can optionally omit items with the greatest number of responses missing when conducting the distribution test.

Usage

sumScoreEAP(grp, ..., qwidth = 6, qpoints = 49L, .twotier = TRUE)

Arguments

- **grp**: a list containing the model and data. See the details section.
- **...**: Not used. Forces remaining arguments to be specified by name.
- **qwidth**: DEPRECATED
- **qpoints**: DEPRECATED
- **.twotier**: whether to enable the two-tier optimization

Details

When two-tier covariance structure is detected, EAP scores are only reported for primary factors. It is possible to compute EAP scores for specific factors, but it is not clear why this would be useful because they are conditional on the specific factor sum scores. Moreover, the algorithm to compute them efficiently has not been published yet (as of Jun 2014).

Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores
The `param` matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in `spec` and order of columns in `param` are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by `param` colnames.

Currently only a multivariate normal distribution is available, parameterized by the mean and `cov`. If `mean` and `cov` are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, `qwidth=2` and `qpoints=5` would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by `EAPscores`.

See Also

Other scoring: `EAPscores()`, `bestToOmit()`, `itemOutcomeBySumScore()`, `observedSumScore()`, `omitItems()`, `omitMostMissing()`

Examples

```r
# see Thissen, Pommerich, Billeaud, & Williams (1995, Table 2)
spec <- list()
spec[1:3] <- list(rpf.grm(outcomes=4))

param <- matrix(c(1.87, .65, 1.97, 3.14,
                   2.66, .12, 1.57, 2.69,
                   1.24, .08, 2.03, 4.3), nrow=4)
# fix parameterization
param <- apply(param, 2, function(p) c(p[1], p[2:4] * -p[1]))

grp <- list(spec=spec, mean=0, cov=matrix(1,1,1), param=param)
sumScoreEAP(grp)
```

---

**Description**

Conduct the sum-score EAP distribution test

**Usage**

```r
sumScoreEAPTest(grp, ..., qwidth = 6, qpoints = 49L, .twotier = TRUE)
```

**Arguments**

- `grp` a list containing the model and data. See the details section.
- `...` Not used. Forces remaining arguments to be specified by name.
- `qwidth` DEPRECATED
Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores

The **param** matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in spec and order of columns in param are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by param colnames.

Currently only a multivariate normal distribution is available, parameterized by the **mean** and **cov**. If **mean** and **cov** are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, qwidth=2 and qpoints=5 would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by **EAPscores**.

References


See Also

Other diagnostic: **ChenThissen1997**, **SitemFit1**, **SitemFit**, **multinomialFit**, **rpf.1dim.fit**
tabulateRows  
*Tabulate data.frame rows*

**Description**

Like `tabulate` but entire rows are the unit of tabulation. The data.frame is not sorted, but must be sorted already.

**Usage**

`tabulateRows(observed)`

**Arguments**

- `observed`: a sorted data.frame holding ordered factors in every column

**See Also**

`orderCompletely`

**Examples**

```r
df <- as.data.frame(matrix(c(sample.int(2, 30, replace=TRUE)), 10, 3))
df <- df[orderCompletely(df),]
tabulateRows(df)
```

toFactorLoading  
*Convert response function slopes to factor loadings*

**Description**

All slopes are divided by the ogive constant. Then the following transformation is applied to the slope matrix.

**Usage**

`toFactorLoading(slope, ogive = rpf.ogive)`

**Arguments**

- `slope`: a matrix with items in the columns and slopes in the rows
- `ogive`: the ogive constant (default `rpf.ogive`)
toFactorThreshold

Details

\[ \frac{\text{slope}}{\left[ 1 + \text{rowSums}(\text{slope}^2) \right]^2} \]

Value

a factor loading matrix with items in the rows and factors in the columns

See Also

Other factor model equivalence: fromFactorLoading(), fromFactorThreshold(), toFactorThreshold()

toFactorThreshold

Convert response function intercepts to factor thresholds

Description

Convert response function intercepts to factor thresholds

Usage

toFactorThreshold(intercept, slope, ogive = rpf.ogive)

Arguments

intercept a matrix with items in the columns and intercepts in the rows
slope a matrix with items in the columns and slopes in the rows
ogive the ogive constant (default rpf.ogive)

Value

a factor threshold matrix with items in the columns and factor thresholds in the rows

See Also

Other factor model equivalence: fromFactorLoading(), fromFactorThreshold(), toFactorLoading()
write.flexmirt

Write a flexMIRT PRM file

Description

[Experimental] This was last updated in 2017 and may no longer work.

Usage

write.flexmirt(groups, file = NULL, fileEncoding = "")

Arguments

- **groups**: a list of groups each with items and latent parameters
- **file**: the destination file name
- **fileEncoding**: how to encode the text file (optional)

Details

Formats item parameters in the way that flexMIRT expects to read them.

NOTE: Support for the graded response model may not be complete.

Format of a group

A model, or group within a model, is represented as a named list.

- **spec**: list of response model objects
- **param**: numeric matrix of item parameters
- **free**: logical matrix of indicating which parameters are free (TRUE) or fixed (FALSE)
- **mean**: numeric vector giving the mean of the latent distribution
- **cov**: numeric matrix giving the covariance of the latent distribution
- **data**: data.frame containing observed item responses, and optionally, weights and frequencies
- **score**: factors scores with response patterns in rows
- **weightColumn**: name of the data column containing the numeric row weights (optional)
- **freqColumn**: name of the data column containing the integral row frequencies (optional)
- **qwidth**: width of the quadrature expressed in Z units
- **qpoints**: number of quadrature points
- **minItemsPerScore**: minimum number of non-missing items when estimating factor scores

The **param** matrix stores items parameters by column. If a column has more rows than are required to fully specify a model then the extra rows are ignored. The order of the items in *spec* and order of columns in **param** are assumed to match. All items should have the same number of latent dimensions. Loadings on latent dimensions are given in the first few rows and can be named by setting rownames. Item names are assigned by **param** colnames.
Currently only a multivariate normal distribution is available, parameterized by the mean and cov. If mean and cov are not specified then a standard normal distribution is assumed. The quadrature consists of equally spaced points. For example, \texttt{qwidth=2} and \texttt{qpoints=5} would produce points -2, -1, 0, 1, and 2. The quadrature specification is part of the group and not passed as extra arguments for the sake of consistency. As currently implemented, OpenMx uses EAP scores to estimate latent distribution parameters. By default, the exact same EAP scores should be produced by \texttt{EAPscores}.
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