The package 'flirt' is a flexible item response theory modeling package. It was updated on February 25, 2015.

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**Author**: Minjeong Jeon, Frank Rijmen, and Sophia Rabe-Hesketh  
**Maintainer**: Minjeong Jeon <jeon.117@osu.edu>  
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**Description**: Estimation of uni- and multi-dimensional explanatory IRT models  
**License**: GPL (>= 2)  
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Description

This package provides a flexible framework for uni- and multi-dimensional explanatory item response theory modeling for binary and polytomous item responses. The flexibility stems from specifying IRT models as generalized linear and nonlinear mixed models (Rijmen, Tuerlinckx, De Boeck, & Kuppens, 2003).

For estimation, the package flirt uses an efficient modified EM algorithm based on the graphical model framework. The modified EM algorithm is much faster than the traditional EM algorithm. For more details on the modified EM algorithm, refer to e.g., Rijmen, F., Vansteelandt, K., & De Boeck, P. (2008).

Currently, uni- and multi-dimensional Rasch models, two-parameter logistic (2PL) IRT models, and bifactor models are available with extensions to multiple groups, item covariates, person covariates, and differential item functioning analyses.

The package flirt is based on the Matlab code BNLflirt (Rijmen and Jeon, 2013) for estimation that employs sub-functions from the Matlab toolbox BNL (Bayesian Networks with Logistic Regression Nodes; Rijmen, 2006).

flirt requires the Matlab Compiler Runtime (MCR) for Matlab 2014a, Windows. Having the correct version of the MCR is critical. If you have a different version of Matlab on your computer, please make sure to remove the MCR that you have and download/install the correct version in the following link:

http://www.mathworks.com/products/compiler/mcr/

To cite flirt,


Details

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Type: Package
Version: 1.15
Date: 2015-2-19
License: GPL
The R script containing sample analyses using \texttt{flirt} is available by contacting the first author.

\textbf{Author(s)}

Minjeong Jeon, Frank Rijmen, and Sophia Rabe-Hesketh
Maintainer: Minjeong Jeon<jeon.117@osu.edu>

\textbf{References}


---

\textbf{anova}

\emph{Anova method for fitted nested models}

\textbf{Description}

A generic function to conduct a likelihood ratio test between two nested models.

\textbf{Usage}

\begin{verbatim}
## S3 method for class flirt
anova(object, object2, ...)
\end{verbatim}

\textbf{Arguments}

\begin{itemize}
  \item \textbf{object} an object inheriting from class \texttt{flirt} for the model under the null hypothesis.
  \item \textbf{object2} an object inheriting from class \texttt{flirt} for the model under the alternative hypothesis.
  \item \textbf{...} additional arguments; currently none is used.
\end{itemize}
Value

An object of either class anova.flirt with components,

name0  the name of object.
L0     the log-likelihood under the null hypothesis (object).
aic0   the AIC value for the model given by object.
bic0   the BIC value for the model given by object.
name1  the name of object2.
L1     the log-likelihood under the alternative hypothesis (object2).
aic1   the AIC value for the model given by object2.
bic1   the BIC value for the model given by object2.
LRT    the value of the Likelihood Ratio Test statistic.
df     the degrees of freedom for the test (i.e., the difference in the number of parameters).
p.value the $p$-value of the test.

Warning

The code does not check if the models are nested. The user is responsible to supply nested models in order for the LRT to be valid.

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

flirt, logLik

Examples

library(flirt)

## verbal aggression data
data(verb2)

# 2-dimensional 2PL model for binary data: a(th+b) parameterization
model1 <- flirt(data=verb2, select=2:25, loading=list(on=TRUE, inside=TRUE),
                mul=list(on=TRUE, dim_info=list(dim1=1:12, dim2=13:24)) )

# 2-dimensional Rasch model
model2 <- flirt(data=verb2, select=2:25,
                mul=list(on=TRUE, dim_info=list(dim1=1:12, dim2=13:24)) )

# LR test
anova(model2, model1) # model1 is nested within model2
charity

Description

This data come from the 38th round of the State Survey conducted by Michigan State University’s Institute for Public Policy and Social Research (2005). The survey was administered to 949 Michigan citizens from May 28 to July 18, 2005, by telephone. The focus of the survey included charitable giving and volunteer activities of Michigan households. Five questions measured the public’s faith and trust in charity organizations.

Format

A data frame with 949 observations on the following five items:

- **ta1** Charitable organizations are more effective now in providing services than they were 5 years ago.
- **ta2** I place a low degree of trust in charitable organizations.
- **ta3** Most charitable organizations are honest and ethical in their use of donated funds.
- **ta4** Generally, charitable organizations play a major role in making our communities better places to live.
- **ta5** On the whole, charitable organizations do not do a very good job in helping those who need help.

The questions had four response categories corresponding to ‘strongly agree’, ‘somewhat agree’, ‘somewhat disagree, and ‘strongly disagree. In this dataset, the responses are coded from 0 to 3, with larger scores indicating less favorable views of charities.

References


Examples

```r
str(charity)
```

 coef

Extract estimated coefficients

Description

A generic function to extract parameter estimates from flirt objects.
Usage

## S3 method for class flirt
c coef(object, ...)

Arguments

object an object inheriting from class flirt.

... additional arguments; currently none is used.

Value

a matrix of the estimated parameters for the fitted model.

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

flirt

Examples

library(flirt)

## verbal aggression data
data(verb2)

# 2-dimensional 2PL model for binary data: a(th+b) parameterization
model1 <- flirt(data=verb2, select=2:25, loading=list(on=TRUE, inside=TRUE),
 mul=list(on=TRUE, dim_info=list(dim1=1:12, dim2=13:24)) )

c coef(model1)

dendrify2

Expandsion of item responses based on an item response tree

Description

Expands a wide-form matrix of item responses based on an item response tree structure

Usage

## S3 method for class flirt
dendrify2(mat, cmx, missing.omit=FALSE, wide=FALSE)
**Arguments**

- **mat**: an integer matrix of IRT responses (columns represent items, rows represent respondents)
- **cmx**: a mapping matrix with as many rows as there are response options for the items
- **missing**: for a long-form data, the data lines with a missing item response are removed
- **wide**: If TRUE, expanded data are provided in a wide form

**Author(s)**

Minjeong Jeon <jeon.117@osu.edu>

**References**


**See Also**

- flirt

**Examples**

```r
library(flirt)

## verbal aggression data
data(verb2)

# expand the data based on a tree structure (mapping matrix)
mapping <- cbind(c(0, 1, 1), c(NA, 0, 1))
wide <- dendrify2(verb2, mapping, wide=TRUE)
```

**Description**

Maximum likelihood estimation of item response theory (IRT) models for binary and polytomous data
Usage

flirt(data, select=NULL, subset=NULL, loading=list(on=FALSE, inside=FALSE),
mul=list(on=FALSE, dim_info=NULL, cov_info=NULL),
bifac=list(on=FALSE, dim_info=NULL, cov_info=NULL),
second=list(on=FALSE, dim_info=NULL, cov_info=NULL),
guess=list(on=FALSE),
person_cov=list(on=FALSE, person_matrix=NULL, main=NULL),
item_cov=list(on=FALSE, item_matrix_beta=NULL, item_matrix_alpha=NULL),
dif=list(on=FALSE, dif_beta=NULL, dif_alpha=NULL),
mg=list(on=FALSE, group_matrix=NULL),
mixture=list(on=FALSE, num=NULL),
weight=list(on=FALSE, weight_matrix=NULL),
post=FALSE,
start=list(on=FALSE, npar=NULL, start_info=NULL, start_value=NULL),
constraint=list(on=FALSE, npar=NULL, cons_info=NULL, cons_value=NULL),
evaluate=list(on=FALSE, eval_value=NULL),
control=list(min_percent=NULL, max_it=NULL, nq=NULL, conv=NULL,
link=NULL, adapt=NULL, se_num=NULL, se_emp=NULL, alp_bounds_up=NULL,
verbose=NULL, show=NULL)
)

Arguments

data matrix or data.frame in wide form - persons in rows and items in columns. Group membership, person covariates and sampling weights may be included as additional columns
select vector of item numbers or item names. If data include other than item responses or the user wants to analyze only subset of items, select should be specified.
subset vector of names or numbers of cases (rows) of choice.
loading list.
  • on: logical. If TRUE, a 2PL model family, if FALSE, a 1PL model family (default) is used.
  • inside: logical. When on==TRUE, if inside==TRUE, \( \alpha_i(\theta_p + \beta_i) \) parameterization, if FALSE, \( \alpha_i\theta_p + \beta_i \) parameterization (default) is used.

mul list.
  • on: if TRUE, a multidimensional model, if FALSE, a unidimensional model (default) is used.
  • dim_info: list. If on==TRUE, a list of item numbers or columns for each dimension should be provided.
  • cov_info: matrix or data.frame. If there are person covariates, cov_info should be provided, which indicates which covariates are used in each dimension.

bifac list.
  • on: logical. If TRUE, bifactor model, if FALSE, unidimensional model (default).
  • dim_info: list. If on==TRUE, list of item numbers or columns for each dimension should be provided.
  • cov_info: matrix or data.frame. If there are person covariates, cov_info should be provided, which indicates which covariates are used in each dimension.

second list.
• **on**: logical. If TRUE, second-order (testlet) model, if FALSE, unidimensional model (default).

• **dim_info**: list. If on==TRUE, list of item numbers or columns for each dimension should be provided.

• **cov_info**: matrix or data.frame. If there are person covariates, cov_info should be provided, which indicates which covariates are used in each dimension.

**guess** list.

• **on**: logical. If TRUE, a 3PL model is estimated ($\alpha_i$, $\beta_i$, and $c_i$ parameters), if FALSE, only $\beta_i$ parameters are estimated (default is 1PL models).

**person_cov** list.

• **on**: logical. If TRUE, person covariates columns (or names) or the data matrix should be provided in person_matrix.

• **person_matrix**: column numbers or variable names if part of data, otherwise, matrix or data.frame for the person covariates. Number and order of rows should be the same as those in data. If subset is used, the number of rows should be adjusted accordingly.

• **main**: logical. If main==TRUE, person covariates are treated as main effects in the linear predictor instead of as predictors of a latent regression model. Default is main==FALSE.

**item_cov** list.

• **on**: logical. If TRUE, data matrix for item covariates should be provided either for $\beta_i$ or $\alpha_i$.

• **item_matrix_beta**: matrix or data.frame for item covariates that are regressed on $\beta_i$. Number of rows should be the same as the number of items. If select is used, the number of rows should be adjusted accordingly.

• **item_matrix_alpha**: matrix or data.frame for item covariates that are regressed on $\alpha_i$. Number of rows should be the same as the number of items. If this option is used, standard errors are not estimated. If select is used, the number of rows should be adjusted accordingly.

**dif** list.

• **on**: logical. If TRUE, DIF analysis is performed. FALSE is default.

• **dif_beta**: vector. Item numbers or variable names for DIF for $\beta_i$.

• **dif_alpha**: vector. Item numbers or variable names for DIF for $\alpha_i$.

**mg** list.

• **on**: logical. If TRUE, multiple-group analysis is performed. FALSE is default.

• **group_matrix**: column number or variable name for person membership if part of data, otherwise data.matrix should be provided in group_matrix. Number and order of rows should be the same as those in data. If subset is used, the number of rows should be adjusted accordingly. Persons should be ordered by groups.

**mixture** list.

• **on**: logical. If TRUE, mixture model is specified (currently, not available).

• **num**: logical. If on==TRUE, number of latent classes should be provided.

**weight** list.

• **on**: logical. If TRUE, sampling or frequency weights are included. FALSE is default.
• **weight_matrix**: if on==TRUE, column number or variable name if part of data, otherwise data.matrix for weights should be provided. Number and order of rows should be the same as those in data. If subset is used, the number of rows should be adjusted accordingly.

**post**

logical. if TRUE, expected a posteriori (EAP) (and its variance and covariance), expected sum-scores, and IRT reliability are provided. FALSE is default.

**start**

• **on**: logical. If TRUE, use-specified starting values are used; otherwise, random starting values are used (default).

• **npar**: integer of the total number of parameters.

• **start_info**: vector of the parameter numbers for starting values to be used.

• **start_value**: vector of the starting values for the specified parameters in start_info.

**constraint**

• **on**: logical. If TRUE, users can specify parameter constraints. FALSE is default.

• **npar**: integer of the total number of parameters.

• **cons_info**: vector of the parameter numbers to be constrained.

• **cons_value**: vector of the specific values for the specified parameters to be fixed at.

**evaluate**

• **on**: logical. If TRUE, log-likelihood is evaluated at given parameter values. FALSE is default.

• **eval_value**: vector of parameter values where the log-likelihood is evaluated at.

**control**

list of control options with components:

• **minpercent**: positive real value. Minimum percentage for a response category for polytomous items. If the relative frequency for a category is lower than minpercent, that category is collapsed into the lower adjacent category. Default is 0. To see how the category is collapsed, put the control option show=TRUE.

• **max_it**: positive integer. Maximum number of iterations. Default is 10,000.

• **nq**: positive integer. Numbers of quadrature points. Default is 20. For multidimensional and bifactor models, a vector of quadrature points for each dimension in order (dimension 1, dimension 2, and so on for multidimensional models; general dimension, specific dimension 1, specific dimension 2, and so on for bifactor models). If a scalar is specified, the specified number is used for all dimensions.

• **conv**: positive real value. Convergence criterion. The iteration between EM estimations stops when the maximum absolute difference in the parameter estimates becomes equal or smaller than the criterion between two subsequent iterations. Default is 0.0001.

• **link**: positive integer 1, 2, or 3. or "multinomial", "cumulative", "adjacent". Default is multinomial or 1 for binary data (that leads to logit link) and "adjacent" for polytomous data.

• **adapt**: logical. If TRUE, adaptive quadrature is used. if FALSE, Gauss-Hermite quadrature is used (default).

• **se_num**: logical. If TRUE, standard error estimates are computed using the Hessian matrix obtained by numerical differentiation.

• **se_emp**: logical. If TRUE, standard error estimates are computed using an empirical information matrix.(default) If se_num is TRUE, standard errors are computed using this method are contained as extra attributes. If se_emp is FALSE, these standard errors are used as default standard errors.
flirt

- **alp_bounds_up**: positive integer. Upper boundary value (positive) for \( \alpha_i \). Default is 15. Cannot be used when item covariates are regressed on \( \alpha_i \).
- **alp_bounds_low**: positive integer. Lower boundary value for \( \alpha \). Default is -1. Cannot be used when item covariates are regressed on \( \alpha_i \).
- **verbose**: logical. If TRUE, the iteration number, the maximum absolute difference in the parameter estimates (par_diff) and difference in the log-likelihood (lik_diff) between adjacent iterations are printed.
- **show**: logical. If TRUE, print Matlab output (error messages) on R console.

**Details**

- **Parameterization**: For a linear predictor flirt uses \( \theta_p + \beta_i \) for 1PL models, \( \alpha_i(\theta_p + \beta_i) \) or \( \alpha_i\theta_p + \beta_i \) for 2PL models, and \( \alpha_i g \theta_{pg} + \alpha_s \theta_{ps} + \beta_i \) for bifactor and second-order models, where \( \theta_p \) is the ability of a person \( p \), \( \beta_i \) is the item easiness (or intercept), \( \alpha_i \) is the loading (or slope), and \( \theta_{pg} \) and \( \theta_{ps} \) are abilities for the general \( g \) and specific dimension \( s \) with \( \alpha_ig \) and \( \alpha_is \), respectively. For 3PL models, the guessing parameter \( c_i \) is incorporated in the probability, 
  \[
P_i = c_i + \frac{1-c_i}{1+\exp(-(\alpha_i \theta_p + \beta_i))}.
\]
  For second-order models, \( \alpha_ig/\alpha_is \) is the second-order loading for the \( g \)th first-order factor on the second-order factor \( \theta_{pg} \), which is constant for the items within \( g \)th first-order factor.
- **Polytomous item responses**: Minimum category should be 0.
- **Multiple group analysis**: Group membership should start from 0.
- **Standard errors**: For variance-covariance parameters, standard errors are not provided and NA is returned. For parameters that are constrained, standard errors are not calculated and NA is returned.
- **Starting values, evaluation**: Parameter values (to be fixed at) for variance-covariance parameters should be Cholesky elements of lower triangular matrix \( L (Cov = LL') \)
- **Boundary values**: The maximum boundary values for parameters are set to \( \pm 15 \). The upper and lower boundary values for \( \alpha_i \) can be modified using the control options \( alp_bounds_up \) and \( alp_bounds_low \). If a parameter estimate crosses the boundary value during iterations, the parameter estimate is automatically restricted to the boundary value and no parameter and standard error estimates are provided with a warning message.
- **Missing values**: Missing values should be specified as NA. Missing values in item responses and item design matrices are treated as ignorable, but for missing values in person design, person group, and weight matrices, listwise deletion is used.

**Value**

An object of class flirt, with the following slots that can be extracted using object@

- **pars**: matrix of parameters estimates and standard errors
- **parms**: original parameter estimates from BNLflirt (including cholesky estimates for multidimensional models)
- **info_num**: information matrix (numerical) evaluated at the maximum likelihood estimates
- **se_emp**: standard errors using empirical information matrix (if used)
- **info_emp**: information matrix (empirical) evaluated at the maximum likelihood estimates (if used)
- **loglik**: log-likelihood value at convergence
- **AIC**: Akaike information criterion: \(-2 \cdot \text{loglik} + 2 \cdot npar\), where \( npar \) is number of parameters
**BIC**

Bayesian information criterion: $-2\times loglik + npar \times log(nobs)$, where *nobs* is number of cases (persons)

**npar**

number of parameters

**post**

post analysis with a list of

- eap: expected a posteriori (EAP) ability estimate(s)
- eap_var: variances of expected a posteriori (EAP) ability estimate(s)
- eap_cov: covariance matrix of expected a posteriori (EAP) ability estimate(s)
- exp_s: expected scores
- rel: IRT reliability using empirical priors

**data_inf**

data information with a list of

- nobs: number of people
- ngroup: number of groups
- nitem: number of items
- MS_item: maximum category of items (scalar)
- S_item: categories of all items (vector)

**dim_inf**

dimension information with a list of

- within: within-item model: 1, otherwise: 0
- ndim: number of dimensions
- n_it_dim: number of items in each dimension

**inside**

inside: 1, otherwise: 0 (2PL parameterization)

**model**

1: unidimensional 1PL model family, 2: unidimensional 2PL model family, 3: multidimensional 1PL model family, 4: multidimensional 2PL model family, 5: bifactor model family

**dif_beta**

items that are under investigation for DIF for $\beta_i$

**dif_alpha**

items that are under investigation for DIF for $\alpha_i$

**est_inf**

estimation information with a list of

- adapt: adaptive quadrature
- nqr: number of quadrature points
- conv: convergence criterion
- max_it: total number of iterations
- link: link function
- verbose: verbose
- alp_bounds_up: upper boundary value for $\alpha_i$
- alp_bounds_low: lower boundary value for $\alpha_i$

**Author(s)**

Minjeong Jeon <jeon.117@osu.edu>

**See Also**

`summary`, `coef`, `logLik`, `anova`
Examples

# set directory where the .tar is located.
install.packages("flirt", type="source", repos=NULL)
library(flirt)

# show built-in datasets
data(package="flirt")

# with adjacent link function (partial credit model)
result1 <- flirt(data=charity, subset=1:100,
                 control=list(minpercent=0.05, nq=5, link="adjacent", show=TRUE))

## verbal aggression data
data(verb2)

# 2-dimensional 2PL model for binary data
# with a(th+b) parameterization
result2 <- flirt(data=verb2, select=2:25,
                 mul=list(on=TRUE, dim_info=list(dim1=1:12, dim2=13:24)))

# output
result2
summary(result2)
coef(result2)
logLik(result2)

# 1PL graded response model for polytomous responses
# with cumulative link function (graded response model)
data(charity)
result3 <- flirt(data=charity, subset=1:100,
                 control=list(minpercent=0.05, nq=5, link="cumulative", show=TRUE))


---

IRF

**Plot item response curves**

Description

A function to plot item response curves as a function of latent ability for unidimensional 1PL, 2PL, and 3PL models.

Usage

## S3 method for class flirt
IRF(alpha=NULL, beta, guess=NULL, inside=NULL, ylim=NULL)
IRF_pol

Plot category response curves for polytomous items

Description
A function to plot category response curves as a function of a unidimensional ability for unidimensional graded response models (with a cumulative logit link)

Usage

## S3 method for class flirt
IRF_pol(alpha=NULL, beta, guess=NULL, inside=NULL, ylim=NULL)
Arguments

alpha \( \alpha_i \) parameter estimates. If NULL, \( \alpha_i = 1 \)

beta \( \beta_{ir} \) parameter estimates for category \( r \) to item \( i \)

guess \( c_i \) (guessing) parameter estimates. If NULL, \( c_i = 0 \)

inside If TRUE, \( P_i = c_i + \frac{(1-c_i)}{1+exp(-\alpha_i(\theta_p+\beta_{ir}))} \) is estimated

ylim the y limits of the plot.

Details

For a single item with three to six response categories.

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

flirt

Examples

library(flirt)

## charity data
result4 <- flirt(data=charity, subset=1:100, control=list(minpercent=0.05, nq=5, link="cumulative"))

beta <- result4@pars[2:14,1]

# item response function
IRF_pol(beta=beta[1:2]) # item 1 with three categories
IRF_pol(beta=beta[3:5]) # item 2 with four categories

---

item_design_bin  Verbal Aggression Data: item covariates

Description

Data frame for item design matrix with binary responses for the verbal aggression data. There are five columns for for intercept, four item covariates (dowant, otherself, blame, express).

Format

A data frame in size 24 by 5.

intercept: 1
dowant: do:1 vs. want:0
otherself: other-to-blame:0, self-to-blame:1
blame: curse:0.5, scold:0.5 vs. shout:-1
express: scold:-1 vs. curse:0.5, shout:0.5
References


Examples

str(item_design_bin)

---

Verbal Aggression Data: item covariates

Description

Data frame for item design matrix for polytomous responses for the verbal aggression data. There are six columns for intercept, four item covariates (dowant, otherself, blame, express), and one variable for category 2 (compared to 1) (same for 24 items). Two adjacent lines represent an item, one for category 1 and next for category 2 (category 0 is reference). This item design matrix assumes that a difference between category 1 to 2 is the same for all items. For unequal category effects, 24 extra columns (one for each item) are needed instead of one column (item_design_pol_full).

Format

A data frame in size 48 by 6.

  intercept: 1
  dowant: do:1 vs. want:0
  otherself: other-to-blame:0, self-to-blame:1
  blame: curse:0.5, scold:0.5 vs. shout:-1
  express: scold:-1 vs. curse:0.5, shout:0.5
  category: category 1 (perhaps):0, category 2 (yes):1

References


Examples

str(item_design_pol)
Verbal Aggression Data: item covariates

Description

Data frame for item design matrix for polytomous responses for the verbal aggression data. There are 29 columns for intercept, four item covariates (blame, express, dowant, otherself), and 24 variables for category 2 (compared to 1). Two adjacent lines represent an item, one for category 1 and next for category 2 (category 0 is reference). This item design matrix assumes that a difference between category 1 to 2 is different across items. For equal category effects, only one extra column is needed instead of 24 columns (item_design_pol).

Format

A data frame in size 48 by 29.

intercept: 1
dowant: do:1 vs. want:0
otherself: other-to-blame:0, self-to-blame:1
blame: curse:0.5, scold:0.5 vs. shout:-1
express: scold:-1 vs. curse:0.5, shout:0.5
cat_i1 to cat_i24: category 1 (perhaps):0, category 2 (yes):1 for item 1 to 24

References


Examples

str(item_design_pol_full)

Verbal Aggression Data

Description

Data frame for item design matrix for polytomous responses for the verbal aggression data. There are 25 columns for 24 items and one variable for category 2 (compared to 1) (same for 24 items). Two adjacent lines represent an item, one for category 1 and next for category 2 (category 0 is reference). This item design matrix assumes that a difference between category 1 to 2 is the same for all items (as in a rating scale model).

Format

A data frame in size 48 by 25.
i1 to i24 indicator variable for item 1 to 24
category: category 1 (perhaps):0, category 2 (yes):1
References


Examples

str(item_design_rating)

Item_info

Plot item information function

Description

A function to plot item information functions for unidimensional 1PL, 2PL, and 3PL models

Usage

## S3 method for class flirt
Item_info(alpha=NULL, beta, guess=NULL , inside=NULL, ylim=NULL)

Arguments

alpha  \( \alpha_i \) parameter estimates. If NULL, \( \alpha_i = 1 \)
beta  \( \beta_i \) parameter estimates
guess  \( c_i \) (guessing) parameter estimates. If NULL, \( c_i = 0 \)
inside  If TRUE, \( I_i(\theta) = \alpha_i^2 \times \frac{(P_i-c_i)}{(1-c_i)^2} \times \frac{(1-P_i)}{P_i^2} \) is computed
ylim  the y limits of the plot.

Details

For single and multiple items.

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

flirt
Examples

library(flirt)

## verbal aggression data
data(verb2)

# 2-dimensional 2PL model for binary data: a(th+b) parameterization
result2 <- flirt(data=verb2, loading=list(on=T, inside=T), control=list(nq=5) )
alpha <- result2@pars[1:24,2]
beta <- result2@pars[25:48,1]

# item information function for first four items
Item_info(beta= beta[1:4])

linking

Data example for IRT linking

Description

Sample data for cases with two test forms. The data include three common items, two items from test form A, and one item from test form B.

Format

A data frame in size 30 by 6.

c1 to c3: three common items
f1.1 to f2.1: two items from test form A
f1.2: one item from test form B

Examples

str(linking)

logLik

Extract log-likelihood

Description

A generic function to extract the log-likelihood from flirt objects.

Usage

## S3 method for class flirt
logLik(object, ...)


person_design

Arguments

object  
an object inheriting from class flirt.

...  
additional arguments; currently none is used.

Value

Returns an object of class logLik giving the log-likelihood value and npar (number of freely estimated parameters)

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

flirt

Examples

library(flirt)

## verbal aggression data

data(verb2)

# 2-dimensional 2PL model for binary data: a(th+b) parameterization
model1 <- flirt(data=verb2, select=2:25, loading=list(on=TRUE, inside=TRUE),
    mul=list(on=TRUE, dim_info=list(dim1=1:12, dim2=13:24))

logLik(model1)

---

person_design  

Verbal Aggression Data: Person design matrix

Description

Design matrix for person covariates

Format

A data.frame for 316 cases with the following variable:

male  subject’s gender. male:1 and female:0

References

**Examples**

```r
str(person_design)
```

---

**Description**

This data come from the British sample of the 1992 Eurobarometer Survey (Reif and Melich, 1992) on perceptions of science and technology provided by Bartholomew et al. (2008). There are seven statements (such as ‘Science and technology are making our lives healthier, easier, and more comfortable’) and the response categories are ‘strongly disagree’, ‘disagree to some extent’, ‘agree to some extent’, and ‘strongly agree’.

Bartholomew et al. (2008) considered a between-item two-dimensional generalized partial credit model by using two item clusters, 1) items 1, 3, 4, and 7, and 2) items 2, 5, and 6.

**Format**

A data frame with 392 observations with 7 items. Each item has five response categories from ‘strongly disagree’ to ‘strongly agree’.

**References**


**Examples**

```r
str(science)
```

---

**Description**

This data come from Thissen et al. (1993, p.71) that examined performance of under-graduates on four spelling items ‘infidelity’, ‘panoramic’, ‘succumb’ and ‘girder’. Each spelling item was scored either as correct or incorrect. The sample includes 285 male and 374 female undergraduate students from the University of Kansas.

**Format**

A data frame with 659 observations on the four spelling items. There is one more variable, male that takes value 1 for male and 0 for female.
References


Examples

str(spelling)

spelling_w  spelling item responses with frequency weights

Description

This data come from Thissen et al. (1993, p.71) that examined performance of undergraduates on four spelling items ‘infidelity’, ‘panoramic’, ‘succumb’ and ‘girder’. Each spelling item was scored either as correct or incorrect. The sample includes 285 male and 374 female undergraduate students from the University of Kansas.

Format

A data frame with 30 observations on the four spelling items. There is one covariate, male that takes value 1 for male and 0 for female. There is a frequency weight, wt2 that indicates the number of people who share the same item response patterns and gender.

References


Examples

str(spelling_w)

std_coef  Standardized factor loading parameter estimates and correlation matrix

Description

std_coef compute standardized factor loading parameter estimates and correlation matrix.
std_cov scales a covariance matrix into the corresponding correlation matrix.
Usage

## S3 method for class flirt
std_coef(est, dim_info, cov_matrix)
## S3 method for class flirt
std_cov(dim_info, cov_matrix)

Arguments

est               a vector of loading parameter estimates from flirt
dim_info          a list of items for each dimension
cov_matrix        a square numeric variance_covariance matrix

Value

std_coef returns a list of standardized loading parameter estimates and correlation matrix. std_cov returns a correlation matrix.

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

flirt

Examples

library(flirt)

## verbal aggression data: polytmous item responses
data(verb2)

# 2-dimensional 2PL model for binary data
# a*th + b parameterization
model1 <- flirt(data=resp, loading=list(on=TRUE, inside=FALSE),
    mul=list(on=TRUE, dim_info=list(dim1=1:12, dim2=13:24)) , control=list(nq=5) )

## function for standardized loadings and covariance matrix
# length 24, unstandardized loading parameter estimates
est <- coef(model1)[1:24,1]

# length 3 (sd1, cov12, sd2) unstandardized sd and cov estimates vector
cov_el <- coef(model1)[51:53,1]

# covariance matrix
cov_matrix <- matrix(c(cov_el[1]^2, cov_el[3], cov_el[3],cov_el[2]^2),2,2, byrow=FALSE)

# list
dim_info <- list(dim1=1:12, dim2=13:24)

test0 <- std_coef(est=est, dim_info=dim_info, cov_matrix= cov_matrix)
test1 <- std_cov(dim_info=dim_info, cov_matrix= cov_matrix)
Summary method for fitted models

Description

A generic function to produce result summaries from flirt objects.

Usage

## S3 method for class flirt
summary(object, ...)

Arguments

object an object inheriting from class flirt.

... additional arguments; currently none is used.

Value

An object of class summary.flirt with components,

Data nobs: number of observations (nobs), nitem: number of items, maxcat: maximum response category, and ngroup: number of groups

Model fit npar: number of parameters, AIC, BIC, and loglik

Parameterization for 2PL models, $\alpha\theta + \beta$ or $\alpha(\theta + \beta)$

Type between-item or within-item multidimensional models

Dimension number of dimensions and number of items in each dimension for multidimensional and bifactor models

Parameter estimates parameter estimates and standard errors.

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

flirt
Examples

```r
library(flirt)

## verbal aggression data
data(verb2)

# 2-dimensional 2PL model for binary data: a(th+b) parameterization
model1 <- flirt(data=verb2, select=2:25, loading=list(on=TRUE, inside=TRUE),
                 mul=list(on=TRUE, dim_info=list(dim1=1:12, dim2=13:24)) )

summary(model1)
```

Test_info

Plot test information function

Description

A function to plot test information function for unidimensional 1PL, 2PL, and 3PL models

Usage

```r
## S3 method for class flirt
Test_info(alpha=NULL, beta, guess=NULL , inside=NULL, ylim=NULL)
```

Arguments

- `alpha`: $\alpha_i$ parameter estimates. If `NULL`, $\alpha_i = 1$
- `beta`: $\beta_i$ parameter estimates
- `guess`: $c_i$ (guessing) parameter estimates. If `NULL`, $c_i = 0$
- `inside`: If `TRUE`, $I(\theta) = \sum_i \left[ \alpha_i^2 \times \frac{(P_i-c_i)}{(1-c_i)^2} \times \frac{(1-P_i)}{P_i} \right]$ is computed
- `ylim`: the y limits of the plot.

Author(s)

Minjeong Jeon <jeon.117@osu.edu>

See Also

- `flirt`

Examples

```r
library(flirt)

## verbal aggression data
data(verb2)
```
# 2-dimensional 2PL model for binary data: a(th+b) parameterization
result2 <- flirt(data=verb2, loading=list(on=T, inside=T), control=list(nq=5) )
alpha <- result2@pars[1:24,2]
beta <- result2@pars[25:48,1]

# test information function
Test_info(beta= beta)

---

**verb2**  
*Verbal Aggression Data: binary responses*

**Description**

Data frame in wide form for the verbal aggression data.

**Format**

A data frame for 316 cases with the following variables:

- **y1-y24** binary item responses to item 1 to item 24. The order of items are the same as that in VerbAgg (long form). No:0, Perhaps and Yes:1

**References**


**Examples**

str(verb2)

---

**verb3**  
*Verbal Aggression Data: polytomous responses*

**Description**

Data frame in wide form for the verbal aggression data.

**Format**

A data frame for 316 cases with the following variables.

- **y1-y24** original polytomous item responses to item 1 to item 24. The order of items are the same as that in VerbAgg (long form). No:0, Perhaps:1, and Yes:2

**References**

Description

These are the item responses to a questionnaire on verbal aggression. These data are used throughout De Boeck, P. and Wilson, M. (2004) to illustrate various forms of item response models.

Format

A data frame with 7,584 observations on the following 13 variables.

- **Anger**: the subject’s Trait Anger score as measured on the State-Trait Anger Expression Inventory (STAXI)
- **Gender**: the subject’s gender - a factor with levels M and F
- **item**: the item on the questionnaire, as a factor
- **resp**: the subject’s response to the item - an ordered factor with levels no < perhaps < yes
- **id**: the subject identifier, as a factor
- **btype**: behavior type - a factor with levels curse, scold and shout
- **situ**: situation type - a factor with levels other and self indicating other-to-blame and self-to blame
- **mode**: behavior mode - a factor with levels want and do
- **r2**: dichotomous version of the response - a factor with levels N and Y

Source

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

References


Examples

```r
str(VerbAgg)
```
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