Package ‘MIRT4FC’

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Type Package

Title Fit FC-Model by *i*StEM Algorithm

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Description The objective of MIRT4FC is to efficiently implement various forced-choice models using the istem algorithm.Currently, it includes Multi-Unidimensional Pairwise Preference Two Parameter Logistic Model (MUPP-2PLM, Morillo et al., 2016), Multi-Unidimensional Pairwise Preference Generalized Graded Unfolding Model (MUPP-GGUM ,Stark et al., 2005) and so on. We plan to continue updating and adding new models in the future. In addition to item parameter estimation capabilities, our R package also offers the ability to estimate ability parameters using MAP, EAP, and MLE methods. It can generate simulated response matrices, calculate standard errors (SE) for both ability and item parameters, and include a set of empirical data.

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Encoding UTF-8

Data inst/data/MAP_data.rda

LazyData true

RoxygenNote 7.2.3

Imports armspp, doParallel, foreach, coda, mvnfast, stats, utils, Matrix

Depends parallel

URL https://github.com/SAL-Lab-ECNU/MIRT4FC

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*i*StEM *Improved Stochastic EM algorithm for solving FC model*

Description

Improved Stochastic EM algorithm for solving Force Choice: Multi-Unidimensional Pairwise-Preference Two-Parameter Logistic (FC: MUPP-2PL) model.

Usage

```
iStEM(Y, BID ,positive=rep(TRUE,nrow(BID)), blocksize=3, res='rank', M=10, B=20,
  model='2PL', SE='XPD', sigma=NULL, theta=NULL, fix.sigma = FALSE,
  burnin.maxitr=40, maxitr=500, eps1=1.5, eps2=0.4, frac1=0.2, frac2=0.5, cores=NULL,
  h=NULL)
```

Arguments

Y	A # of subjects * # of blocks matrix; item responses.
BID	A # of statements * 3 matrix; item information, columns are "Block", "Item" and "Dimensions".
positive	A logical vector; indicating whether each statement is positive directional or not.
blocksize	A number; block size of FC (2/3/4).
res	A string; response format('pick'/'rank'/'mole'), pick-2/rank-2/mole-2 are equivalent, rank-3/mole-3 are equivalent.
M	A number; # of batch.
B	A number; # of iterations in each batch.
model	A string; FC model('2PL').
sigma	A # of dimensions * # of dimensions matrix; initial sigma parameters.
theta	A # of subjects * # of dimensions matrix; initial theta parameters.
fix.sigma	Logical; TRUE if sigma is estimated.
burnin.maxitr	A number; max burn-in allowed.
maxitr	A number; max iterations allowed.
eps1	A number; stability criteria.
eps2	A number; convergence criterion.
frac1	A number; cutoffs for calculating Geweke z.

frac2 A number; cutoffs for calculating Geweke z.

cores A number; number of parallel cores.

h A number; The perturbation constant of the differential method.

Examples

```
#################### A simulation example based on the MUPP-2PL model###############
########Set simulation information
library (MIRT4FC)
D <- 6                                          # Dimension
nitem.per.dim <- 10                             # Iems number per dimension
nblock <- D * nitem.per.dim / 3                 # Blocks number
set.seed(123456)                                # Set random seed
# Simulate block-item-demension correspondence table
BID <- data.frame (Block = rep (1:nblock,each=3),
                   Item=rep (1:3, nblock),
                   Dim=c(combn(D,3) [, sample(choose(D,3), nblock,replace = TRUE)]))
# Simulate item parameter truth value
item.par <- data.frame (a = seq_len (D * nitem.per.dim))
item.par <- within (item.par, {
  a <- runif (D*nitem.per.dim,0.7,3)
  b <- rnorm (D*nitem.per.dim)
  d <- a*b
})
item.par$d <- c (t (aggregate (item.par$d, by=list (BID$Block), function(x)x-mean(x)) [, -1]))
N <- 1000                                       # Sample number
v <- matrix (0.5, D, D)                         # Intertrait correlation
diag (v) <- 1
# Simulate latent trait parameter truth value
theta <- mvnfast::rmvn (N, seq(-1, 1, length.out = D),sigma = v)
######## Generate a simulated dataset
Y <- data.sim (item.par, theta, BID, blocksize = 3, res = 'rank')
######## Item parameter estimation
fit <- iStEM (Y, BID, maxitr = 100, blocksize = 3, res = 'rank', fix.sigma = TRUE)
print(fit)
```

data.sim *Simulated dataset for multivariate FC item response theory model.*

Description

Simulated dataset for multivariate FC item response theory model.

Usage

```
data.sim (item.par, theta, BID, blocksize = 3, res = 'rank')
```

Arguments

BID A # of statements * 3 matrix; item information, columns are "Block", "Item" and "Dimensions".

blocksize A number; block size of FC (2/3/4).

res A string; response format('pick'/'rank'/'mole'), pick-2 (blocksize = 2)/rank-2/mole-2 are equivalent, rank-3/mole-3 are equivalent.

item.par A data frame; parameters for a and d.

theta A # of subjects * # of dimensions matrix; theta parameters.

Value

A # of subjects x # of block number matrix.

Examples

```
#################### A simulation example based on the MUPP-2PL model###############
########Set simulation information
library (MIRT4FC)
D <- 6                                    # Dimension
nitem.per.dim <- 10                       # Iems number per dimension
nblock <- D * nitem.per.dim / 3           # Blocks number
set.seed(123456)                          # Set random seed
# Simulate block-item-demension correspondence table
BID <- data.frame (Block = rep (1:nblock,each=3),
                   Item=rep (1:3, nblock),
                   Dim=c(combn(D,3) [, sample(choose(D,3), nblock,replace = TRUE)]))
# Simulate item parameter truth value
item.par <- data.frame (a = seq_len (D * nitem.per.dim))
item.par <- within (item.par, {
  a <- runif (D*nitem.per.dim,0.7,3)
  b <- rnorm (D*nitem.per.dim)
  d <- a*b
})
item.par$d <- c (t (aggregate (item.par$d, by=list (BID$Block), function(x)x-mean(x)) [, -1]))
N <- 1000                                 # Sample number
v <- matrix (0.5, D, D)                   # Intertrait correlation
diag (v) <- 1
# Simulate latent trait parameter truth value
theta <- mvnfast::rmvn (N, seq(-1, 1, length.out = D),sigma = v)
######## Generate a simulated dataset
Y <- data.sim (item.par, theta, BID, blocksize = 3, res = 'rank')
print(Y)
```

MAP_data *A Triple Empirical Data for Dominance Model.*

Description

This data set contains a real data set of 1391 participants on 88 triplets. In each triplet, participants had to rank the three alternative items according to their preference.

Usage

```
MAP_data
```

Format

A large matrix of 1391 observations containing information on 6 variables. In each block, 3 items (e.g., A/B/C) measure 3 different traits.

A>B>C=1; A>C>B=2; B>A>C=3; B>C>A=4; C>A>B=5; C>B>A=6

Examples

This is an empirical example for the paper "A 2PLM-RANK Multidimensional Forced-choice Model and its Fast Estimation"

```
########################an empirical example for the 2PL-RANK model#######################
######### Read dataset
library (MIRT4FC)
Y <- data("MAP_data")
######### Item parameter estimation
fit <- iStEM (Y, BID, maxitr = 150, blocksize = 3, res = 'rank', fix.sigma = TRUE)
print(fit)
```

theta.est *Provide the function of estimating latent traits.*

Description

Simulated dataset for multivariate FC item response theory model.

Usage

```
theta.est (Y,a,d,BID,sigma,prior=TRUE,blocksize=3,res='rank',model='2PL')
```

Arguments

Y A # of subjects * # of blocks matrix; item responses.

a A vector; length = # of statements, initial alpha parameters.

d A vector; length = # of statements, initial beta parameters.

BID A # of statements * 3 matrix; item information, columns are "Block", "Item" and "Dimensions".

sigma A # of dimensions * # of dimensions matrix; initial sigma parameters.

prior Logical; TRUE if prior is added

blocksize A number; block size of FC (2/3/4).

res A string; response format('pick'/'rank'/'mole'), pick-2/rank-2/mole-2 are equivalent, rank-3/mole-3 are equivalent.

model A string; FC model('2PL').

Value

A # of subjects x # of block number matrix.

Examples

```
#################### A simulation example based on the 2PL model######################
########Set simulation information
library (MIRT4FC)
  D <- 6
nitem.per.dim <- 10
nblock <- D * nitem.per.dim / 3
set.seed(123456)

item.par <- data.frame(a=seq_len(D*nitem.per.dim))
item.par <- within(item.par,{
   a <- runif(D*nitem.per.dim,0.7,3)
   b <- rnorm(D*nitem.per.dim)
   d <- a*b
})
a=matrix(item.par$a,nrow=3,ncol = 20)
d=matrix(item.par$d,nrow=3,ncol = 20)

BID <- data.frame(Block=rep(1:nblock,each=3),
                          Item=rep(1:3,nblock),
                          Dim=c(combn(D,3)[,sample(choose(D,3),nblock,replace = TRUE)]))
item.par$d <- c(t(aggregate(item.par$d,by=list(BID$Block),function(x)x-mean(x))[,-1]))
N <- 1000

v <- matrix(0,D,D)
diag(v) <- 1
eigen(v)$values
theta <- mvnfast::rmvn(N,rep(0,each = D),sigma = v)
Y <- data.sim(item.par,theta,BID,blocksize = 3,res = "rank")

thetaest <- theta.est(Y,a,d,BID=BID,sigma=v,prior=TRUE,blocksize=3,res='rank',model='2PL')
```