

Package ‘LNIRT’

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Type Package

Title LogNormal Response Time Item Response Theory Models

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Imports MASS, methods, stats, utils

Description Allows the simultaneous analysis of responses and response times in an Item Response Theory (IRT) modelling framework. Supports variable person speed functions (intercept, trend, quadratic), and covariates for item and person (random) parameters. Data missing-by-design can be specified. Parameter estimation is done with a MCMC algorithm. LNIRT replaces the package CIRT, which was written by Rinke Klein Entink. For reference, see the paper by Fox, Klein Entink and Van der Linden (2007), “Modeling of Responses and Response Times with the Package cirt”, Journal of Statistical Software, <doi:10.18637/jss.v020.i07>.

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LNIRT

*Log-normal response time IRT modelling***Description**

Log-normal response time IRT modelling

Usage

```
LNIRT(RT, Y, data, XG = 1000, guess = FALSE, par1 = FALSE,
      residual = FALSE, td = TRUE, WL = FALSE, alpha, beta, phi, lambda,
      XPA = NULL, XPT = NULL, XIA = NULL, XIT = NULL, MBDY, MBDT)
```

Arguments

RT	a Person-x-Item matrix of log-response times (time spent on solving an item).
Y	a Person-x-Item matrix of responses.
data	either a list or a simLNIRT object containing the response time and response matrices and optionally the predictors for the item and person parameters. If a simLNIRT object is provided, in the summary the simulated item and time parameters are shown alongside of the estimates. If the required variables cannot be found in the list, or if no data object is given, then the variables are taken from the environment from which LNIRT is called.
XG	the number of MCMC iterations to perform (default: 1000).
guess	include guessing parameters in the IRT model (default: false).
par1	use alternative parameterization (default: false).
residual	compute residuals, requires > 1000 iterations (default: false).
td	estimate the time-discrimination parameter (default: true).
WL	define the time-discrimination parameter as measurement error variance parameter (default: false).
alpha	an optional vector of pre-defined item-discrimination parameters.
beta	an optional vector of pre-defined item-difficulty parameters.
phi	an optional vector of predefined time discrimination parameters.
lambda	an optional vector of predefined time intensity parameters.
XPA	an optional matrix of predictors for the person ability parameters.
XPT	an optional matrix of predictors for the person speed parameters.
XIA	an optional matrix of predictors for the item-difficulty parameters.
XIT	an optional matrix of predictors for the item-intensity parameters.
MBDY	an optional indicator matrix for response missings due to the test design (0=missing by design, 1=not missing by design).
MBDT	an optional indicator matrix for response time missings due to the test design (0=missing by design, 1=not missing by design).

Value

an object of class LNIRT.

Examples

```
## Not run:
# Log-normal response time IRT modelling
data <- simLNIRT(N = 500, K = 20, rho = 0.8, WL = FALSE)
out <- LNIRT(RT = RT, Y = Y, data = data, XG = 1500, residual = TRUE, WL = FALSE)
summary(out) # Print results
out$Post.Means$Item.Difficulty # Extract posterior mean estimates

library(coda)
mcmc.object <- as.mcmc(out$MCMC.Samples$Item.Difficulty) # Extract MCMC samples for coda
summary(mcmc.object)
plot(mcmc.object)

## End(Not run)
```

LNIRTQ	<i>Log-normal response time IRT modelling with variable person speed (intercept, trend, quadratic)</i>
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Description

Log-normal response time IRT modelling with variable person speed (intercept, trend, quadratic)

Usage

```
LNIRTQ(Y, RT, X, XG = 1000)
```

Arguments

Y	a Person-x-Item matrix of responses.
RT	a Person-x-Item matrix of log-response times (time spent on solving an item).
X	explanatory (time) variables for random person speed (default: (1:N.items - 1)/N.items).
XG	the number of MCMC iterations to perform (default: 1000).

Value

an object of class LNIRTQ.

LNRT

*Log-normal response time modelling***Description**

Log-normal response time modelling

Usage

```
LNRT(RT, data, XG = 1000, residual = FALSE, td = TRUE, WL = FALSE,
     XPT = NULL, XIT = NULL)
```

Arguments

RT	a Person-x-Item matrix of log-response times (time spent on solving an item).
data	either a list or a simLNIRT object containing the response time matrix. If a simLNIRT object is provided, in the summary the simulated time parameters are shown alongside of the estimates. If the RT variable cannot be found in the list, or if no data object is given, then the RT variable is taken from the environment from which LNRT is called.
XG	the number of MCMC iterations to perform (default: 1000).
residual	compute residuals, requires > 1000 iterations (default: false).
td	estimate the time-discrimination parameter (default: true).
WL	define the time-discrimination parameter as measurement error variance parameter (default: false).
XPT	an optional matrix of predictors for the person speed parameters.
XIT	an optional matrix of predictors for the item time intensity parameters.

Value

an object of class LNRT.

Examples

```
## Not run:
# Log-normal response time modelling
data <- simLNIRT(N = 500, K = 20, rho = 0.8, WL = FALSE)
out <- LNRT(RT = RT, data = data, XG = 1500, residual = TRUE, td = TRUE, WL = FALSE)
summary(out) # Print results
out$Post.Means$Time.Intensity # Extract posterior mean estimates

library(coda)
mcmc.object <- as.mcmc(out$MCMC.Samples$Time.Intensity) # Extract MCMC samples for coda
summary(mcmc.object)
plot(mcmc.object)

## End(Not run)
```

LNRTQ	<i>Log-normal response time modelling with variable person speed (intercept, trend, quadratic)</i>
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Description

Log-normal response time modelling with variable person speed (intercept, trend, quadratic)

Usage

LNRTQ(RT, X, XG = 1000)

Arguments

RT	a Person-x-Item matrix of log-response times (time spent on solving an item).
X	explanatory (time) variables for random person speed (default: (1:N.items - 1)/N.items).
XG	the number of MCMC iterations to perform (default: 1000).

Value

an object of class LNRTQ.

simLNIRT	<i>Simulate data for log-normal response time IRT modelling</i>
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Description

Simulate data for log-normal response time IRT modelling

Usage

simLNIRT(N, K, rho, td = FALSE, WL = FALSE, kpa, kpt, kia, kit)

Arguments

N	the number of persons.
K	the number of items.
rho	the correlation between the person ability and person speed parameter.
td	set time-discrimination to one (default: false).
WL	define the time-discrimination parameter as measurement error variance parameter (default: false).
kpa	the number of predictors for the person ability parameters (optional).
kpt	the number of predictors for the person speed parameters (optional).
kia	the number of predictors for the item-difficulty parameters (optional).
kit	the number of predictors for the item time intensity parameters (optional).

Value

an object of class simLNIRT.

simLNIRTQ	<i>Simulate data for log-normal response time IRT modelling with variable person speed (intercept, trend, quadratic)</i>
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Description

Simulate data for log-normal response time IRT modelling with variable person speed (intercept, trend, quadratic)

Usage

```
simLNIRTQ(N, K, ...)
```

Arguments

N	the number of persons.
K	the number of items.
...	optional arguments.

Value

an object of class simLNIRTQ.

summaryIRTQ	<i>Summary Function for LNIRTQ</i>
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Description

Summary Function for LNIRTQ

Usage

```
summaryIRTQ(out, data)
```

Arguments

out	a LNIRTQ object (the fitted model)
data	a simLNIRTQ object (the simulated data, optional)

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