Package 'ggdmc'

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Type Package

Title Cognitive Models

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Description Hierarchical Bayesian models. The package provides tools to fit two response time models, using the population-based Markov Chain Monte Carlo.

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URL https://github.com/yxlin/ggdmc

BugReports https://github.com/yxlin/ggdmc/issues

Imports Rcpp (>= 1.0.7), coda, stats, utils, ggplot2, matrixStats, data.table (>= 1.10.4)

Depends R (>= 3.3.0)

LinkingTo Rcpp (>= 1.0.7), RcppArmadillo (>= 0.7.100.3.0)

Suggests testthat

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Encoding UTF-8

NeedsCompilation yes

Repository CRAN

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Contents

`BuildDMI` *Bind data and models*

Description

Binding a data set with a model object. The function also checks whether they are compatible and adds attributes on a data model instance.

Usage

```
BuildDMI(x, model)
```

Arguments

x	data as in data frame
model	a model object

Value

a data model instance

`BuildModel` *Create a model object*

Description

A model object consists of arraies with model attributes.

Usage

```
BuildModel(
  p.map,
  responses,
  factors = list(A = "1"),
  match.map = NULL,
  constants = numeric(0),
  type = "norm",
  posdrift = TRUE,
  verbose = TRUE
)

## S3 method for class 'model'
print(x, p.vector = NULL, ...)

## S3 method for class 'dmi'
print(x, ...)
```

Arguments

p.map	parameter map. This option maps a particular factorial design to model parameters
responses	specifying the response names and levels
factors	specifying a list of factors and their levels
match.map	match map. This option matches stimuli and responses

constants	specifying the parameters with fixed values
type	specifying model type, either "rd" or "norm".
posdrift	a Boolean, switching between enforcing strict postive drift rates by using truncated normal distribution. This option is only useful in "norm" model type.
verbose	Print p.vector, constants and model type
x	a model object
p.vector	parameter vector
...	other arguments

Examples

```
model <- BuildModel(
        p.map     = list(a = "1", v = "1", z = "1", d = "1", t0 = "1",
                         sv = "1", sz = "1", st0 = "1"),
        constants = c(st0 = 0, d = 0, sz = 0, sv = 0),
        match.map = list(M = list(s1 = "r1", s2 = "r2")),
        factors   = list(S = c("s1", "s2")),
        responses = c("r1", "r2"),
        type      = "rd")
```

BuildPrior *Specifying Parameter Prior Distributions*

Description

BuildPrior sets up parameter prior distributions for each model parameter. p1 and p2 refer to the first and second parameters a prior distribution.

Usage

```
BuildPrior(
  p1,
  p2,
  lower = rep(NA, length(p1)),
  upper = rep(NA, length(p1)),
  dists = rep("tnorm", length(p1)),
  untrans = rep("identity", length(p1)),
  types = c("tnorm", "beta", "gamma", "lnorm", "unif", "constant", "tnorm2", NA)
)
```

Arguments

p1	the first parameter of a distribution
p2	the second parameter of a distribution
lower	lower support (boundary)

upper	upper support (boundary)
dists	a vector of character string specifying a distribution.
untrans	whether to do log transformation. Default is not
types	available distribution types

Details

Four distribution types are implemented:

1. Normal and truncated normal, where: p1 = mean, p2 = sd. It specifies a normal distribution when bounds are set -Inf and Inf,
2. Beta, where: p1 = shape1 and p2 = shape2 (see pbeta). Note the uniform distribution is a special case of the beta with p1 and p2 = 1),
3. Gamma, where p1 = shape and p2 = scale (see pgamma). Note p2 is scale, not rate,
4. Lognormal, where p1 = meanlog and p2 = sdlog (see plnorm).

Value

a list of list

---

check_pvec *Does a model object specify a correct p.vector*

Description

Check a parameter vector

Usage

```
check_pvec(p.vector, model)
```

Arguments

p.vector	parameter vector
model	a model object

ConvertChains *Prepare posterior samples for plotting functions version 1*

Description

Convert MCMC chains to a data frame for plotting functions

Usage

```
ConvertChains(x, start = 1, end = NA, pll = TRUE)
```

Arguments

x	posterior samples
start	which iteration to start
end	end at which iteration
pll	a Boolean switch to make posterior log likelihood

dbeta_lu *A modified dbeta function*

Description

A modified dbeta function

Usage

```
dbeta_lu(x, p1, p2, lower, upper, lg = FALSE)
```

Arguments

x	quantile
p1	shape1 parameter
p2	shape2 parameter
lower	lower bound
upper	upper bound
lg	logical; if TRUE, return log density.

dcauchy_l *A modified dcauchy functions*

Description

A modified dcauchy functions

Usage

```
dcauchy_l(x, p1, p2, lg = FALSE)
```

Arguments

x	quantile
p1	location parameter
p2	scale parameter
lg	log density?

dconstant *A pseudo constant function to get constant densities*

Description

Used with constant prior

Usage

```
dconstant(x, p1, p2, lower, upper, lg = FALSE)
```

Arguments

x	quantile
p1	constant value
p2	unused argument
lower	dummy varlable
upper	dummy varlable
lg	log density?

deviance.model *Calculate the statistics of model complexity*

Description

Calculate deviance for a model object for which a log-likelihood value can be obtained, according to the formula -2*log-likelihood.

Usage

```
## S3 method for class 'model'
deviance(object, ...)
```

Arguments

object	posterior samples
...	other plotting arguments passing through dot dot dot.

dgamma_l *A modified dgamma function*

Description

A modified dgamma function

Usage

```
dgamma_l(x, p1, p2, lower, upper, lg = FALSE)
```

Arguments

x	quantile
p1	shape parameter
p2	scale parameter
lower	lower bound
upper	upper bound
lg	log density?

DIC *Deviance information criteria*

Description

Calculate DIC and BPIC.

Usage

```
DIC(object, ...)

BPIC(object, ...)
```

Arguments

object	posterior samples
...	other plotting arguments passing through dot dot dot.

dlnorm_l *A modified dlnorm functions*

Description

A modified dlnorm functions

Usage

```
dlnorm_l(x, p1, p2, lower, upper, lg = FALSE)
```

Arguments

x	quantile
p1	meanlog parameter
p2	sdlog parameter
lower	lower bound
upper	upper bound
lg	log density?

dtnorm *Truncated Normal Distribution*

Description

Random number generation, probability density and cumulative density functions for truncated normal distribution.

Usage

```
dtnorm(x, p1, p2, lower, upper, lg = FALSE)

rtnorm(n, p1, p2, lower, upper)

ptnorm(q, p1, p2, lower, upper, lt = TRUE, lg = FALSE)
```

Arguments

x, q	vector of quantiles;
p1	mean (must be scalar).
p2	standard deviation (must be scalar).
lower	lower truncation value (must be scalar).
upper	upper truncation value (must be scalar).
lg	log probability. If TRUE (default is FALSE) probabilities p are given as log(p).
n	number of observations. n must be a scalar.
lt	lower tail. If TRUE (default) probabilities are P[X <= x], otherwise, P[X > x].

Value

a column vector.

Examples

```
## rtn example
dat1 <- rtnorm(1e5, 0, 1, 0, Inf)
hist(dat1, breaks = "fd", freq = FALSE, xlab = "",
     main = "Truncated normal distributions")

## dtn example
x <- seq(-5, 5, length.out = 1e3)
dat1 <- dtnorm(x, 0, 1, -2, 2, 0)
plot(x, dat1, type = "l", lwd = 2, xlab = "", ylab= "Density",
     main = "Truncated normal distributions")

## ptn example
x <- seq(-10, 10, length.out = 1e2)
```

```
mean <- 0
sd <- 1
lower <- 0
upper <- 5
dat1 <- ptnorm(x, 0, 1, 0, 5, lg = TRUE)
```

`effectiveSize_hyper` *Calculate effective sample sizes*

Description

`effectiveSize` calls `effectiveSize` in **coda** package to calculate sample sizes.

Usage

```
effectiveSize_hyper(x, start, end, digits, verbose)

effectiveSize_many(x, start, end, verbose)

effectiveSize_one(x, start, end, digits, verbose)

effectiveSize(
  x,
  hyper = FALSE,
  start = 1,
  end = NA,
  digits = 0,
  verbose = FALSE
)
```

Arguments

`x`	posterior samples
`start`	starting iteration
`end`	ending iteraton
`digits`	printing how many digits
`verbose`	printing more information
`hyper`	a Boolean switch to extract hyper attribute

Examples

```
#################################40
## effectiveSize example
#################################40
## Not run:
es1 <- effectiveSize_one(hsam[[1]], 1, 100, 2, TRUE)
es2 <- effectiveSize_one(hsam[[1]], 1, 100, 2, FALSE)
```

```
es3 <- effectiveSize_many(hsam, 1, 100, TRUE)
es4 <- effectiveSize_many(hsam, 1, 100, FALSE)
es5 <- effectiveSize_hyper(hsam, 1, 100, 2, TRUE)
es6 <- effectiveSize(hsam, TRUE, 1, 100, 2, TRUE)
es7 <- effectiveSize(hsam, TRUE, 1, 100, 2, FALSE)
es8 <- effectiveSize(hsam, FALSE, 1, 100, 2, TRUE)
es9 <- effectiveSize(hsam, FALSE, 1, 100, 2, FALSE)
es10 <- effectiveSize(hsam[[1]], FALSE, 1, 100, 2, TRUE)

## End(Not run)
```

---

gelman *Potential scale reduction factor*

Description

gelman function calls the function, gelman.diag in the **coda** package to calculates PSRF.

Usage

```
gelman(
  x,
  hyper = FALSE,
  start = 1,
  end = NA,
  confidence = 0.95,
  transform = TRUE,
  autoburnin = FALSE,
  multivariate = TRUE,
  split = TRUE,
  subchain = FALSE,
  nsubchain = 3,
  digits = 2,
  verbose = FALSE,
  ...
)

hgelman(
  x,
  start = 1,
  end = NA,
  confidence = 0.95,
  transform = TRUE,
  autoburnin = FALSE,
  split = TRUE,
  subchain = FALSE,
  nsubchain = 3,
  digits = 2,
```

```
  verbose = FALSE,
  ...
)
```

Arguments

x	posterior samples
hyper	a Boolean switch, indicating posterior samples are from hierarchical modeling
start	start iteration
end	end iteration
confidence	confident inteval
transform	turn on transform
autoburnin	turn on auto burnin
multivariate	multivariate Boolean switch
split	split whether split mcmc chains; When split is TRUE, the function doubles the number of chains by spliting into 1st and 2nd halves.
subchain	whether only calculate a subset of chains
nsubchain	indicate how many chains in a subset
digits	print out how many digits
verbose	print more information
...	arguments passing to coda gelman.diag.

Examples

```
## Not run:
rhat1 <- hgelman(hsam); rhat1
rhat2 <- hgelman(hsam, end = 51); rhat2
rhat3 <- hgelman(hsam, confidence = .90); rhat3
rhat4 <- hgelman(hsam, transform = FALSE); rhat4
rhat5 <- hgelman(hsam, autoburnin = TRUE); rhat5
rhat6 <- hgelman(hsam, split = FALSE); rhat6
rhat7 <- hgelman(hsam, subchain = TRUE); rhat7
rhat8 <- hgelman(hsam, subchain = TRUE, nsubchain = 4);
rhat9 <- hgelman(hsam, subchain = TRUE, nsubchain = 4,
digits = 1, verbose = TRUE);

hat1 <- gelman(hsam[[1]], multivariate = FALSE); hat1
hat2 <- gelman(hsam[[1]], hyper = TRUE, verbose = TRUE); hat2
hat3 <- gelman(hsam, hyper = TRUE, verbose = TRUE); hat3
hat4 <- gelman(hsam, multivariate = TRUE, verbose = FALSE);
hat5 <- gelman(hsam, multivariate = FALSE, verbose = FALSE);
hat6 <- gelman(hsam, multivariate = FALSE, verbose = TRUE);
hat7 <- gelman(hsam, multivariate = T, verbose = TRUE);

## End(Not run)
```

GetNsim *Get a n-cell matrix*

Description

Constructs a matrix, showing how many responses to in each cell. The function checks whether the format of n and ns conform.

Usage

```
GetNsim(model, n, ns)
```

Arguments

model	a model object.
n	number of trials.
ns	number of subjects.

Details

n can be:

1. an integer for a balanced design,
2. a matrix for an unbalanced design, where rows are subjects and columns are cells. If the matrix is a row vector, all subjects have the same n in each cell. If it is a column vector, all cells have the same n. Otherwise each entry specifies the n for a particular subject x cell combination. See below for concrete examples.

Examples

```
model <- BuildModel(
  p.map     = list(A = "1", B = "R", t0 = "1", mean_v = "M", sd_v = "M",
                st0 = "1"),
  match.map = list(M = list(s1 = 1, s2 = 2)),
  constants = c(sd_v.false = 1, st0 = 0),
  factors   = list(S = c("s1","s2")),
  responses = c("r1", "r2"),
  type      = "norm")

######################30
## Example 1
######################30
GetNsim(model, ns = 2, n = 1)
#      [,1] [,2]
# [1,]    1    1
# [2,]    1    1

######################30
```

```
## Example 2
#######################30
n <- matrix(c(1:2), ncol = 1)
#      [,1]
# [1,]    1  ## subject 1 has 1 response for each cell
# [2,]    2  ## subject 2 has 2 responses for each cell

GetNsim(model, ns = 2, n = n)
#      [,1] [,2]
# [1,]    1    1
# [2,]    2    2

#######################30
## Example 3
#######################30
n <- matrix(c(1:2), nrow = 1)
#      [,1] [,2]
# [1,]    1    2
GetNsim(model, ns = 2, n = n)
#     [,1] [,2]
# [1,]   1    2 ## subject 1 has 1 response for cell 1 and 2 responses for cell 2
# [2,]   1    2 ## subject 2 has 1 response for cell 1 and 2 responses for cell 2

#######################30
## Example 4
#######################30
n <- matrix(c(1:4), nrow=2)
#      [,1] [,2]
# [1,]    1    3
# [2,]    2    4
ggdmc::GetNsim(model, ns = 2, n = n)
#      [,1] [,2]
# [1,]    1    3 ## subject 1 has 1 response for cell 1 and 3 responses for cell 2
# [2,]    2    4 ## subject 2 has 2 responses for cell 1 and 4 responses for cell 2
```

`GetParameterMatrix` *Constructs a ns x npar matrix,*

Description

The matrix is used to simulate data. Each row represents one set of parameters for a participant.

Usage

```
GetParameterMatrix(x, nsub, prior = NA, ps = NA, seed = NULL)
```

Arguments

`x`	a model object
`nsub`	number of subjects.

prior	a prior object
ps	a vector or a matirx.
seed	an integer specifying a random seed.

Details

One must enter either a vector or a matrix as true parameters to the argument, ps, when presuming to simulate data based on a fixed-effect model. When the assumption is to simulate data based on a random-effect model, one must enter a prior object to the argument, prior to first randomly generate a true parameter matrix.

Value

a ns x npar matrix

Examples

```
model <- BuildModel(
p.map     = list(a ="1", v = "1",z = "1", d = "1", sz = "1", sv = "1",
           t0 = "1", st0 = "1"),
match.map = list(M = list(s1 = "r1", s2 ="r2")),
factors   = list(S = c("s1", "s2")),
constants = c(st0 = 0, d = 0),
responses = c("r1", "r2"),
type      = "rd")

p.prior <- BuildPrior(
  dists = c("tnorm", "tnorm", "beta", "beta", "tnorm", "beta"),
  p1    = c(a = 1, v = 0, z = 1, sz = 1, sv = 1, t0 = 1),
  p2    = c(a = 1, v = 2, z = 1, sz = 1, sv = 1, t0 = 1),
  lower = c(0, -5, NA, NA, 0, NA),
  upper = c(2,  5, NA, NA, 2, NA))

## Example 1: Randomly generate 2 sets of true parameters from
## parameter priors (p.prior)
GetParameterMatrix(model, 2, p.prior)
##            a         v         z        sz       sv        t0
## [1,] 1.963067  1.472940 0.9509158 0.5145047 1.344705 0.0850591
## [2,] 1.512276 -1.995631 0.6981290 0.2626882 1.867853 0.1552828

## Example 2: Use a user-selected true parameters
true.vector  <- c(a=1, v=1, z=0.5, sz=0.2, sv=1, t0=.15)
GetParameterMatrix(model, 2, NA, true.vector)
##      a v   z  sz sv   t0
## [1,] 1 1 0.5 0.2  1 0.15
## [2,] 1 1 0.5 0.2  1 0.15
GetParameterMatrix(model, 2, ps = true.vector)

## Example 3: When a user enter arbritary sequence of parameters.
## Note sv is before sz. It should be sz before sv
## See correct sequence, by entering "attr(model, 'p.vector')"
```

```
## GetParameterMatrix will rearrange the sequence.
true.vector  <- c(a=1, v=1, z=0.5, sv=1, sz = .2, t0=.15)
GetParameterMatrix(model, 2, NA, true.vector)
##      a v   z  sz sv   t0
## [1,] 1 1 0.5 0.2  1 0.15
## [2,] 1 1 0.5 0.2  1 0.15
```

`GetPNames` *Extract parameter names from a model object*

Description

Extract parameter names from a model object

Usage

```
GetPNames(x)
```

Arguments

`x`	a model object

`get_os` *Retrieve information of operating system*

Description

A wrapper function to extract system information from `Sys.info` and `.Platform`

Usage

```
get_os()
```

Examples

```
get_os()
## sysname
## "linux"
```

ggdmc *Bayeisan computation of response time models*

Description

ggdmc uses the population-based Markov chain Monte Carlo to conduct Bayesian computation on cognitive models.

Author(s)

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References

Heathcote, A., Lin, Y.-S., Reynolds, A., Strickland, L., Gretton, M. & Matzke, D., (2018). Dynamic model of choice. *Behavior Research Methods*. https://doi.org/10.3758/s13428-018-1067-y.

Turner, B. M., & Sederberg P. B. (2012). Approximate Bayesian computation with differential evolution, *Journal of Mathematical Psychology*, 56, 375–385.

Ter Braak (2006). A Markov Chain Monte Carlo version of the genetic algorithm Differential Evolution: easy Bayesian computing for real parameter spaces. *Statistics and Computing*, 16, 239-249.

iseffective *Model checking functions*

Description

The function tests whether we have drawn enough samples.

Usage

```
iseffective(x, minN, nfun, verbose = FALSE)
```

Arguments

x	posterior samples
minN	specify the size of minimal effective samples
nfun	specify to use the mean or median function to calculate effective samples
verbose	print more information

isflat *Model checking functions*

Description

The function tests whether Markov chains converge prematurelly:

Usage

```
isflat(
  x,
  p1 = 1/3,
  p2 = 1/3,
  cut_location = 0.25,
  cut_scale = Inf,
  verbose = FALSE
)
```

Arguments

x	posterior samples
p1	the range of the head of MCMC chains
p2	the range of the tail of the MCMC chains
cut_location	how far away a location chains been considered as stuck
cut_scale	how far away a scale chains been considered as stuck
verbose	print more information

ismixed *Model checking functions*

Description

The function tests whether Markov chains are mixed well.

Usage

```
ismixed(x, cut = 1.01, split = TRUE, verbose = FALSE)
```

Arguments

x	posterior samples
cut	psrf criterion for well mixed
split	whether to split MCMC chains. This is an argument passing to gelman function
verbose	print more information

See Also

gelman)

`isstuck` *Model checking functions*

Description

The function tests whether Markov chains encounter a parameter region that is difficult to search. `CheckConverged` is a wrapper function running the four checking functions, `isstuck`, `isflat`, `ismixed` and `iseffective`.

Usage

```
isstuck(x, hyper = FALSE, cut = 10, start = 1, end = NA, verbose = FALSE)

CheckConverged(x)
```

Arguments

`x`	posterior samples
`hyper`	a Boolean switch, extracting hyper attribute.
`cut`	the criteria for suggesting abnormal chains found
`start`	start iteration
`end`	end iteration
`verbose`	print more information

`likelihood` *Calculate likelihoods*

Description

These function calculate likelihoods. `likelihood_rd` implements the equations in Voss, Rothermund, and Voss (2004). These equations calculate diffusion decision model (Ratcliff & Mckoon, 2008). Specifically, this function implements Voss, Rothermund, and Voss's (2004) equations A1 to A4 (page 1217) in C++.

Usage

```
likelihood(p_vector_r, data, min_lik = 1e-10)
```

Arguments

p_vector_r	a parameter vector
data	data model instance
min_lik	minimal likelihood.

Value

a vector

References

Voss, A., Rothermund, K., & Voss, J. (2004). Interpreting the parameters of the diffusion model: An empirical validation. *Memory & Cognition*, **32(7)**, 1206-1220.

Ratcliff, R. (1978). A theory of memory retrival. *Psychological Review*, **85**, 238-255.

Examples

```
model <- BuildModel(
p.map     = list(A = "1", B = "1", t0 = "1", mean_v = "M", sd_v = "1",
             st0 = "1"),
match.map = list(M = list(s1 = 1, s2 = 2)),
factors   = list(S = c("s1", "s2")),
constants = c(st0 = 0, sd_v = 1),
responses = c("r1", "r2"),
type      = "norm")

p.vector <- c(A = .25, B = .35,  t0 = .2, mean_v.true = 1,
          mean_v.false = .25)
dat <- simulate(model, 1e3,  ps = p.vector)
dmi <- BuildDMI(dat, model)
den <- likelihood(p.vector, dmi)

model <- BuildModel(
p.map     = list(a = "1", v = "1", z = "1", d = "1", t0 = "1", sv = "1",
             sz = "1", st0 = "1"),
constants = c(st0 = 0, d = 0),
match.map = list(M = list(s1 = "r1", s2 = "r2")),
factors   = list(S = c("s1", "s2")),
responses = c("r1", "r2"),
type      = "rd")

p.vector <- c(a = 1, v = 1, z = 0.5, sz = 0.25, sv = 0.2, t0 = .15)
dat <- simulate(model, 1e2, ps = p.vector)
dmi <- BuildDMI(dat, model)
den <- likelihood (p.vector, dmi)
```

mcmc_list.model *Create a MCMC list*

Description

Create a MCMC list

Usage

```
mcmc_list.model(x, start = 1, end = NA, pll = TRUE)
```

Arguments

x	posterior samples
start	start from which iteration
end	end at which iteration
pll	a Boolean switch for calculating posterior log-likelihood

PickStuck *Which chains get stuck*

Description

Calculate each chain separately for the mean (across many MCMC iterations) of posterior log-likelihood. If the difference of the means and the median (across chains) of the mean of posterior is greater than the cut, chains are considered stuck. The default value for cut is 10. unstick manually removes stuck chains from posterior samples.

Usage

```
PickStuck(
  x,
  hyper = FALSE,
  cut = 10,
  start = 1,
  end = NA,
  verbose = FALSE,
  digits = 2
)
```

Arguments

x	posterior samples
hyper	whether x are hierarhcial samples
cut	a criterion deciding if a chain is stuck.
start	start to evaluate from which iteration.
end	end at which iteration for evaeuation.
verbose	a boolean switch to print more information
digits	print how many digits. Default is 2

Value

PickStuck gives an index vector; unstick gives a DMC sample.

Examples

```
model <- BuildModel(
p.map     = list(A = "1", B = "1", t0 = "1", mean_v = "M", sd_v = "1", st0 = "1"),
match.map = list(M = list(s1 = 1, s2 = 2)),
factors   = list(S = c("s1", "s2")),
constants = c(st0 = 0, sd_v = 1),
responses = c("r1", "r2"),
type      = "norm")
p.vector <- c(A = .75, B = .25, t0 = .2, mean_v.true = 2.5, mean_v.false = 1.5)

p.prior <- BuildPrior(
  dists = c("tnorm", "tnorm", "beta", "tnorm", "tnorm"),
  p1    = c(A = .3, B = .3, t0 = 1, mean_v.true = 1, mean_v.false = 0),
  p2    = c(1, 1,   1, 3, 3),
  lower = c(0,  0,  0, NA, NA),
  upper = c(NA,NA,  1, NA, NA))

## Not run:
dat <- simulate(model, 30, ps = p.vector)
dmi <- BuildDMI(dat, model)
sam <- run(StartNewsamples(dmi, p.prior))
bad <- PickStuck(sam)

## End(Not run)
```

---

plot_prior *Plot prior distributions*

Description

plot_prior plots one member in a prior object. plot.prior plots all members in a prior object.

Usage

```
plot_prior(
  i,
  prior,
  xlim = NA,
  natural = TRUE,
  npoint = 100,
  trans = NA,
  save = FALSE,
  ...
)

## S3 method for class 'prior'
plot(x, save = FALSE, ps = NULL, ...)
```

Arguments

i	an integer or a character string indicating which parameter to plot
prior	a prior object
xlim	set the range of on x axis. This is usually the range for each parameter.
natural	default TRUE.
npoint	default to plot 100
trans	default NA. trans can be a scalar or vector.
save	whether to save the data out
...	other plotting arguments passing through dot dot dot.
x	a prior object
ps	true parameter vectors or matrix in the case of many observation units

Examples

```
p.prior <- BuildPrior(
           dists = rep("tnorm", 7),
           p1    = c(a = 2,   v.f1 = 4,  v.f2 = 3,  z = 0.5, sv = 1,
                     sz = 0.3, t0 = 0.3),
           p2    = c(a = 0.5, v.f1 = .5, v.f2 = .5, z = 0.1, sv = .3,
                     sz = 0.1, t0 = 0.05),
           lower = c(0,-5, -5, 0, 0, 0, 0),
           upper = c(5, 7,  7, 1, 2, 1, 1))

plot_prior("a", p.prior)
plot_prior(2, p.prior)
plot(p.prior)
```

print.prior *Print Prior Distribution*

Description

a convenient function to rearrange p.prior or an element in a pp.prior as a data frame for inspection.

Usage

```
## S3 method for class 'prior'
print(x, ...)
```

Arguments

x	a list of prior distributions list, usually created by BuildPrior
...	other arguments

Value

a data frame listing prior distributions and their settings

Examples

```
pop.mean  <- c(a=1,  v.f1=1,  v.f2=.2, z=.5, sz=.3,  sv.f1=.25, sv.f2=.23,
               t0=.3)
pop.scale <- c(a=.2, v.f1=.2, v.f2=.2, z=.1, sz=.05, sv.f1=.05, sv.f2=.05,
               t0=.05)

p.prior <- BuildPrior(
  dists = rep("tnorm", 8),
  p1    = pop.mean,
  p2    = pop.scale,
  lower = c(0, -5, -5, 0, 0, 0, 0, 0),
  upper = c(2,  5,  5, 1, 2, 2, 1, 1))

print(p.prior)
```

random *Generate random numbers*

Description

A wrapper function for generating random numbers of either the model type, rd, or norm.

Usage

```
random(type, pmat, n, seed = NULL)
```

Arguments

type	a character string of the model type
pmat	a matrix of response x parameter
n	number of observations
seed	an integer specifying a random seed

---

rlba_norm *Generate Random Responses of the LBA Distribution*

Description

rlba_norm used the LBA process to generate response times and responses.

Usage

```
rlba_norm(n, A, b, mean_v, sd_v, t0, st0, posdrift)
```

Arguments

n	is the numbers of observation.
A	start point upper bound, a vector of a scalar.
b	decision threshold, a vector or a scalar.
mean_v	mean drift rate vector
sd_v	standard deviation of drift rate vector
t0	non-decision time, a vector.
st0	non-decision time variation, a vector.
posdrift	if exclude negative drift rates

Value

a n x 2 matrix of response time (first column) and responses (second column).

rprior *Parameter Prior Distributions*

Description

Probability density functions and random generation for parameter prior distributions.

Usage

```
rprior(prior, n = 1)
```

Arguments

prior	a list of list usually created by BuildPrior to store the information about parameter prior distributions.
n	number of observations/random draws

Examples

```
p.prior <- BuildPrior(
 dists = c("tnorm", "tnorm", "beta", "tnorm", "beta", "beta"),
 p1    = c(a = 1, v = 0, z = 1, sz = 1, sv = 1, t0 = 1),
 p2    = c(a = 1, v = 2, z = 1, sz = 1, sv = 1, t0 = 1),
 lower = c(0,-5, NA, NA, 0, NA),
 upper = c(2, 5, NA, NA, 2, NA))

rprior(p.prior, 9)
##               a           v         z         sz        sv         t0
## [1,] 0.97413686  0.78446178 0.9975199 -0.5264946 0.5364492 0.55415052
## [2,] 0.72870190  0.97151662 0.8516604  1.6008591 0.3399731 0.96520848
## [3,] 1.63153685  1.96586939 0.9260939  0.7041254 0.4138329 0.78367440
## [4,] 1.55866180  1.43657110 0.6152371  0.1290078 0.2957604 0.23027759
## [5,] 1.32520281 -0.07328408 0.2051155  2.4040387 0.9663111 0.06127237
## [6,] 0.49628528 -0.19374770 0.5142829  2.1452972 0.4335482 0.38410626
## [7,] 0.03655549  0.77223432 0.1739831  1.4431507 0.6257398 0.63228368
## [8,] 0.71197612 -1.15798082 0.8265523  0.3813370 0.4465184 0.23955415
## [9,] 0.38049166  3.32132034 0.9888108  0.9684292 0.8437480 0.13502154

pvec <- c(a=1, v=1, z=0.5, sz=0.25, sv=0.2,t0=.15)
p.prior  <- BuildPrior(
  dists = rep("tnorm", 6),
  p1    = c(a=2,   v=2.5, z=0.5, sz=0.3, sv=1,  t0=0.3),
  p2    = c(a=0.5, v=.5,  z=0.1, sz=0.1, sv=.3, t0=0.05) * 5,
  lower = c(0,-5, 0, 0, 0, 0),
  upper = c(5, 7, 2, 2, 2, 2))
```

`simulate.model` *Simulate response time data*

Description

Simulate response time data either for one subject or multiple subjects. The simulation is based on a model object. For one subject, one must supply a true parameter vector to the `ps` argument.

Usage

```
## S3 method for class 'model'
simulate(object, nsim = NA, seed = NULL, nsub = NA, prior = NA, ps = NA, ...)
```

Arguments

`object`	a model object.
`nsim`	number of trials / responses. `n` can be a single number for a balanced design or a matrix for an unbalanced design, where rows are subjects and columns are design cells. If the matrix has one row then all subjects have the same `n` in each cell, if it has one column then all cells have the same `n`; Otherwise each entry specifies the `n` for a particular subject x design cell combination.
`seed`	a user specified random seed.
`nsub`	number of subjects
`prior`	a prior object
`ps`	a true parameter vector or matrix.
`...`	additional optional arguments.

Details

For multiple subjects, one can enter a matrix (or a row vector) as true parameters. Each row is to generate data separately for a subject. This is the fixed-effect model. To generate data based on a random-effect model, one must supply a prior object. In this case, `ps` argument is unused. Note in some cases, a random-effect model may fail to draw data from the model, because true parameters are randomly drawn from a prior object. This would happen sometimes in diffusion model, because certain parameter combinations are considered invalid.

`ps` can be a row vector, in which case each subject has identical parameters. It can also be a matrix with one row per subject, in which case it must have `ns` rows. The true values will be saved as `parameters` attribute in the output object.

Value

a data frame

`StartNewsamples` *Start new model fits*

Description

Fit a hierarchical or a fixed-effect model, using Bayeisan optimisation. We use a specific type of pMCMC algorithm, the DE-MCMC. This particular sampling method includes crossover and two different migration operators. The migration operators are similar to random-walk algorithm. They wouold be less efficient to find the target parameter space, if been used alone.

Usage

```
StartNewsamples(
  data,
  prior = NULL,
  nmc = 200,
  thin = 1,
  nchain = NULL,
  report = 100,
  rp = 0.001,
  gammamult = 2.38,
  pm_Hu = 0.05,
  pm_BT = 0.05,
  block = TRUE,
  ncore = 1,
  add = FALSE,
  is_old = FALSE
)

run(
  samples,
  nmc = 500,
  thin = 1,
  report = 100,
  rp = 0.001,
  gammamult = 2.38,
  pm_Hu = 0,
  pm_BT = 0,
  block = TRUE,
  ncore = 1,
  add = FALSE,
  is_old = TRUE
)
```

Arguments

`data`	data model instance(s)

prior	prior objects. For hierarchical model, this must be a list with three sets of prior distributions. Each is respectively named, "pprior", "location", and "scale".
nmc	number of Monte Carlo samples
thin	thinning length
nchain	number of chains
report	progress report interval
rp	tuning parameter 1
gammamult	tuning parameter 2. This is the step size.
pm_Hu	probability of migration type 0 (Hu & Tsui, 2010)
pm_BT	probability of migration type 1 (Turner et al., 2013)
block	Only for hierarchical modeling. A Boolean switch for update one parameter at a time
ncore	Only for non-hierarchical, fixed-effect models with many subjects.
add	Boolean whether to add new samples
is_old	start sampling from a DMI or fit samples
samples	posterior samples.

`summary.model` *Summarise posterior samples*

Description

This calls seven different variants of summary function to summarise posterior samples

Usage

```
## S3 method for class 'model'
summary(
  object,
  hyper = FALSE,
  start = 1,
  end = NA,
  hmeans = FALSE,
  hci = FALSE,
  prob = c(0.025, 0.25, 0.5, 0.75, 0.975),
  recovery = FALSE,
  ps = NA,
  type = 1,
  verbose = FALSE,
  digits = 2,
  ...
)
```

Arguments

object	posterior samples
hyper	whether to summarise hyper parameters
start	start from which iteration.
end	end at which iteration. For example, set start = 101 and end = 1000, instructs the function to calculate from 101 to 1000 iteration.
hmeans	a boolean switch indicating to calculate mean of hyper parameters
hci	boolean switch; whether to calculate credible intervals of hyper parameters
prob	a numeric vector, indicating the quantiles to calculate
recovery	a boolean switch indicating if samples are from a recovery study
ps	true parameter values. This is only for recovery studies
type	calculate type 1 or 2 hyper parameters
verbose	print more information
digits	printing digits
...	other arguments

Examples

```
## Not run:
est1 <- summary(hsam[[1]], FALSE)
est2 <- summary(hsam[[1]], FALSE, 1, 100)

est3 <- summary(hsam)
est4 <- summary(hsam, verbose = TRUE)
est5 <- summary(hsam, verbose = FALSE)

hest1 <- summary(hsam, TRUE)

## End(Not run)
```

---

summary_mcmc_list *Summary statistic for posterior samples*

Description

Calculate summary statistics for posterior samples

Usage

```
summary_mcmc_list(object, prob = c(0.025, 0.25, 0.5, 0.75, 0.975), ...)
```

Arguments

object	posterior samples
prob	summary quantile summary
...	other arguments passing in

`TableParameters` *Table response and parameter*

Description

`TableParameters` arranges the values in a parameter vector and creates a response x parameter matrix. The matrix is used by the likelihood function, assigning a trial to a cell for calculating probability densities.

Usage

```
TableParameters(p.vector, cell, model, n1order)
```

Arguments

`p.vector`	a parameter vector
`cell`	a string or an integer indicating a design cell, e.g., `s1.f1.r1` or 1. Note the integer cannot exceed the number of cell. One can check this by entering `length(dimnames(model))`.
`model`	a model object
`n1order`	a Boolean switch, indicating using node 1 ordering. This is only for LBA-like models and its n1PDF likelihood function.

Value

each row corresponding to the model parameter for a response. When `n1.order` is FALSE, TableParameters returns a martix without rearranging into node 1 order. For example, this is used in the `simulate` function. By default `n1.order` is TRUE.

Examples

```
m1 <- BuildModel(
  p.map     = list(a = "1", v = "F", z = "1", d = "1", sz = "1", sv = "F",
                   t0 = "1", st0 = "1"),
  match.map = list(M = list(s1 = "r1", s2 = "r2")),
  factors   = list(S = c("s1", "s2"), F = c("f1","f2")),
  constants = c(st0 = 0, d = 0),
  responses = c("r1","r2"),
  type      = "rd")

m2 <- BuildModel(
  p.map = list(A = "1", B = "1", mean_v = "M", sd_v = "1",
    t0 = "1", st0 = "1"),
  constants = c(st0 = 0, sd_v = 1),
  match.map = list(M = list(s1 = 1, s2 = 2)),
  factors   = list(S = c("s1", "s2")),
  responses = c("r1", "r2"),
  type      = "norm")
```

```
pvec1 <- c(a = 1.15, v.f1 = -0.10, v.f2 = 3, z = 0.74, sz = 1.23,
           sv.f1 = 0.11, sv.f2 = 0.21, t0 = 0.87)
pvec2 <- c(A = .75, B = .25, mean_v.true = 2.5, mean_v.false = 1.5,
           t0 = .2)

print(m1, pvec1)
print(m2, pvec2)

accMat1 <- TableParameters(pvec1, "s1.f1.r1", m1, FALSE)
accMat2 <- TableParameters(pvec2, "s1.r1",    m2, FALSE)

##    a    v   t0    z d   sz   sv st0
## 1.15 -0.1 0.87 0.26 0 1.23 0.11   0
## 1.15 -0.1 0.87 0.26 0 1.23 0.11   0

##    A b  t0 mean_v sd_v st0
## 0.75 1 0.2    2.5    1   0
## 0.75 1 0.2    1.5    1   0
```

`theta2mcmclist` *Convert theta to a mcmc List*

Description

Extracts the parameter array (ie theta) from posterior samples of a partiipant and convert it to a **coda** mcmc.list.

Usage

```
theta2mcmclist(
  x,
  start = 1,
  end = NA,
  split = FALSE,
  subchain = FALSE,
  nsubchain = 3,
  thin = NA
)

phi2mcmclist(
  x,
  start = 1,
  end = NA,
  split = FALSE,
  subchain = FALSE,
  nsubchain = 3
)
```

Arguments

x	posterior samples
start	start iteration
end	end iteraton
split	whether to divide one MCMC sequence into two sequences.
subchain	boolean swith convert only a subset of chains
nsubchain	indicate the number of chains in the subset
thin	thinning lenght of the posterior samples

Details

phi2mcmclist extracts the phi parameter array, which stores the location and scale parameters at the hyper level.

Examples

```
## Not run:
model <- BuildModel(
p.map     = list(a = "RACE", v = c("S", "RACE"), z = "RACE", d = "1",
            sz = "1", sv = "1", t0 = c("S", "RACE"), st0 = "1"),
match.map = list(M = list(gun = "shoot", non = "not")),
factors   = list(S = c("gun", "non"), RACE = c("black", "white")),
constants = c(st0 = 0, d = 0, sz = 0, sv = 0),
responses = c("shoot", "not"),
type      = "rd")

pnames <- GetPNames(model)
npar   <- length(pnames)
pop.mean  <- c(1, 1, 2.5, 2.5, 2.5, 2.5, .50, .50, .4, .4, .4, .4)
pop.scale <- c(.15, .15, 1, 1, 1, 1, .05, .05, .05, .05, .05, .05)
names(pop.mean)  <- pnames
names(pop.scale) <- pnames
pop.prior <- BuildPrior(
  dists = rep("tnorm", npar),
  p1    = pop.mean,
  p2    = pop.scale,
  lower = c(rep(0, 2), rep(-5, 4), rep(0, 6)),
  upper = c(rep(5, 2), rep(7, 4), rep(2, 6)))
p.prior <- BuildPrior(
  dists = rep("tnorm", npar),
  p1    = pop.mean,
  p2    = pop.scale*10,
  lower = c(rep(0, 2), rep(-5, 4), rep(0, 6)),
  upper = c(rep(10, 2), rep(NA, 4), rep(5, 6)))
mu.prior <- BuildPrior(
  dists = rep("tnorm", npar),
  p1    = pop.mean,
  p2    = pop.scale*10,
  lower = c(rep(0,  2), rep(-5, 4), rep(0, 6)),
```

```
  upper = c(rep(10, 2), rep(NA, 4), rep(5, 6)))
sigma.prior <- BuildPrior(
  dists = rep("beta", npar),
  p1    = rep(1, npar),
  p2    = rep(1, npar),
  upper = rep(2, npar))
names(sigma.prior) <- GetPNames(model)
priors <- list(pprior=p.prior, location=mu.prior, scale=sigma.prior)
dat    <- simulate(model, nsim = 10, nsub = 10, prior = pop.prior)
dmi    <- BuildDMI(dat, model)
ps     <- attr(dat, "parameters")

fit0 <- StartNewsamples(dmi, priors)
fit  <- run(fit0)

tmp1 <- theta2mcmclist(fit[[1]])
tmp2 <- theta2mcmclist(fit[[2]], start = 10, end = 90)
tmp3 <- theta2mcmclist(fit[[3]], split = TRUE)
tmp4 <- theta2mcmclist(fit[[4]], subchain = TRUE)
tmp5 <- theta2mcmclist(fit[[5]], subchain = TRUE, nsubchain = 4)
tmp6 <- theta2mcmclist(fit[[6]], thin = 2)

## End(Not run)
```

`unstick_one` *Unstick posterios samples (One subject)*

Description

Unstick posterios samples (One subject)

Usage

```
unstick_one(x, bad)
```

Arguments

x	posterior samples
bad	a numeric vector, indicating which chains to remove

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