Package 'grt'

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Description Functions to generate and analyze data for psychology experiments based on the General Recognition Theory.

Title General Recognition Theory

License GPL (>= 2)

LazyLoad yes

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`grt-package` *General Recognition Theory*

Description

Functions to generate and analyze data for psychology experiments based on the General Recognition Theory.

Details

Package:	grt
Type:	Package
Version:	0.2
Date:	2014-04-09
License:	GPL(>=2)
LazyLoad:	yes

This package is written based mostly on the GRT Toolbox for MATLAB by Alfonso-Reese (2006), although many functions have been renamed and modified from the original in order to make them more general and "R-like."

The functions `grtrnorm` and `grtMeans` are used for design categorization experiments and generating stimuli. The functions `glc`, `gcjc`, `gqc`, and `grg` are used for fitting the general linear classifier, the general conjunctive classifier, the general quadratic classifier, and the general random guessing model, respectively. The `glc`, `gcjc`, and `gqc` have plot methods (`plot.glc`, `plot.gcjc`, `plot.gqc`, `plot3d.glc`, `plot3d.gqc`).

Author(s)

Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

Ashby, F. G., & Gott, R. E. (1988). *Decision rules in the perception and categorization of multidimensional stimuli*. Journal of Experimental Psychology: Learning, Memory, & Cognition, 14, 33-53.

Ashby, F. G. (1992) *Multidimensional models of perception and cognition*. Lawrence Erlbaum Associates.

`coef.glc` *Extract 'glc' or 'gcjc' coefficients*

Description

Extracts the coefficients from the model object `glc`, `glcStruct`, or `gcjc`.

Usage

```
## S3 method for class 'glc'
coef(object, ...)

## S3 method for class 'glcStruct'
coef(object, ...)

## S3 method for class 'gcjc'
coef(object, ...)
```

Arguments

`object`	object of class `glc` or `glcStruct`
`...`	further arguments

Details

Both the object `glc` and `glcStruct` contain the parameters for the decision boundary in the form:

$$a_1x_1 + a_2x_2 \ldots a_nx_n + b = 0$$

This function transforms and returns the coefficients of the function solved with respect the x_n.

For the object `gcjc`, a list of two coefficients (Intercepts) are returned.

Examples

```
data(subjdemo_2d)
fit.2dl <- glc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
plot(fit.2dl, fitdb=FALSE)
abline(coef(fit.2dl), col = "red")
abline(coef(fit.2dl$initpar))

fit.1dx <- update(fit.2dl, . ~ . -y)
abline(v=coef(fit.1dx), col="green")

fit.1dy <- update(fit.2dl, . ~ . -x)
abline(h=coef(fit.1dy), col="blue")
```

`dprime` *Calculate d' (d-prime)*

Description

Obtain the standardized distance between the two probability distributions, known as d' or sensitivity index.

Usage

```
dprime(x,
    category,
    response,
    par = list(),
    zlimit = Inf,
    type = c("SampleIdeal", "Observer"))

dprimef(means, covs, noise=NULL)
```

Arguments

`x`	a data frame or matrix containing samples from two multivariate normal distributions.
`category`	a vector or factor of labels of populations to which the samples belong

response	a vector or factor specifying the participant's classification responses for each samples
par	object of class glcStruct or a named list containing a set of parameters that specify a general linear decision bound. The list should contain noise, coeffs, bias.
zlimit	numeric. The z-scores (or discriminant scores) beyond the specified value will be truncated and replaced with that value. Default to Inf
type	a character string specifying the type of d' to be returned. If SampleIdeal, d' is calculated based on ideal (or true) category membership as specified in category. If Observer, d' is calculated using the response vector as a grouping factor.
means	a list of numeric vectors containing the means of two distributions
covs	a matrix or a list of matrices containing the variance-covariance matrix of the two distributions
noise	numeric. perceptual and criterial noise expressed as standard deviation. Default to NULL

Details

The function dprime estimates d' from sample data sets, whereas the function dprimef calculates it from population parameters.

In dprime, if any parts of the argument par are missing, the function will estimate an optimal linear decision bound from supplied x and category. The argument response is not used if type is SampleIdeal.

Author(s)

Author of the original Matlab routines: Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

Examples

```
data(subjdemo_2d)
d2 <- subjdemo_2d
db <- glcStruct(noise=10, coeffs=c(0.514,-0.857),bias=-0.000154)
dprime(d2[,2:3], d2$category, d2$response, par = db, zlimit=7, type='SampleIdeal')

mc <- mcovs(category ~ x + y, data=d2)
dprimef(mc$means, mc$covs)
```

`extractAIC` *extractAIC method for class 'glc', 'gqc', 'gcjc', and 'grg'*

Description

Extract Akaike's An Information Criteria from a General Linear, Quadratic, or Conjunctive Classifier, or a General Random Guessing model

Usage

```
## S3 method for class 'glc'
extractAIC(fit, scale, k = 2, ...)

## S3 method for class 'gqc'
extractAIC(fit, scale, k = 2, ...)

## S3 method for class 'gcjc'
extractAIC(fit, scale, k = 2, ...)

## S3 method for class 'grg'
extractAIC(fit, scale, k = 2, ...)
```

Arguments

`fit`	object of class `glc`, `gqc`, `gcjc`, or `grg`
`scale`	unused argument
`k`	numeric specifying the penalty per parameter to be used in calculating AIC. Default to 2.
`...`	further arguments (currently not used).

Details

As with the default method, the criterion used is

$$AIC = -2 \log L + k \times \text{df},$$

where L is the likelihood and df is the degrees of freedom (i.e., the number of free parameters) of `fit`.

Value

A numeric vector of length 2 including:

`df`	the degrees of freedom for the fitted model `fit`.
`AIC`	the Akaike's Information Criterion for `fit`.

Examples

```
data(subjdemo_2d)
#fit a 2d suboptimal model
fit.2dl <- glc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
extractAIC(fit.2dl)
```

---

gaborPatch *Draw a gray-scale Gabor Patch*

Description

Draw a gray-scale Gabor Patch

Usage

```
gaborPatch(sf,
    theta = 0,
    rad = (theta * pi)/180,
    pc = 1,
    sigma = 1/6,
    psi = 0,
    grating = c("cosine", "sine"),
    npoints = 100,
    trim = 0,
    trim.col = .5,
    ...)
```

Arguments

sf	number of cycles per image.
theta	orientation in degree. See 'Details'
rad	orientation in radian
pc	a fraction (0 to 1) specifying the peak contrast of the Gabor
sigma	the standard deviation of the Gaussian mask. Either a single numeric or a numeric vector of length 2.
psi	phase offset in radian
grating	type of grating to be used. Default to 'cosine'.
npoints	number of points per line used to draw the patch.
trim	Gaussian values smaller than the specified value should be trimmed.
trim.col	gray level of the trimmed part of the image, between 0 ('black') and 1 ('white'). Default to .5 ('gray') Setting it to any other value or NA makes the trimmed part transparent.
...	additional parameters for image may be passed as arguments to this function.

Details

The arguments `theta` and `rad` is the same thing but in different units. If both are supplied, `rad` takes the precedence.

Value

invisibly returns the matrix of the plotted values.

Note

This function is written just for fun; it is not optimized for speed or for performance.

References

Fredericksen, R. E., Bex, P. J., & Verstraten, F. A. J. (1997). *How Big is a Gabor and Why Should We Care?* Journal of the Optical Society of America A. 14, 1–12.

Gabor Filter. (2010, June 5). In *Wikipedia, the free encyclopedia.* Retrieved July 7, 2010, from http://en.wikipedia.org/wiki/Gabor_filter

Examples

```
# An imitation of Fredericksen et al.'s (1997) Fig 1.
# that demonstrate the relation between peak contrast
# and perceived size of the Gabor

op <- par(mfcol = c(3, 3), pty = "m", mai = c(0,0,0,0))
for(i in c(.85, .21, .06)){
    for(j in c(1/6, 1/7, 1/8)){
        gaborPatch(20, pc = i, sigma = j)
    }
}
par(op)

## Not run:
# a typical plot of the stimuli and category structure
# often seen in artificial category-learning literatures.
m  <-  list(c(268, 157), c(332, 93))
covs  <-  matrix(c(4538, 4351, 4351, 4538), ncol = 2)
II <- grtrnorm(n = 40, np = 2, means = m, covs = covs,
   clip.sd = 4, seed = 1234)
II$sf <- .25+(II$x1/50)
II$theta <- II$x2*(18/50)

plot(II[,2:3], xlim = c(-100,600), ylim = c(-200,500),
    pch = 21, bg = c("white","gray")[II$category])
abline(a = -175, b = 1)

library(Hmisc)
idx <- c(20, 31, 35, 49, 62)
xpos <- c(0, 100, 300, 350, 550)
ypos <- c(50, 300, 420, -120, 50)
```

```
for(i in 1:5)
{
    j = idx[i]
    segments(x0=II[j,"x1"], y0=II[j,"x2"], x1=xpos[i], y1=ypos[i])
    subplot(gaborPatch(sf=II[j,"sf"], theta=II[j,"theta"]), x=xpos[i], y=ypos[i])
}

## End(Not run)
```

`gcjc` *General Conjunctive Classifier*

Description

Fit a general conjunctive classifier.

Usage

```
gcjc(formula, data, category, par, config = 1, zlimit = Inf,
    fixed = list(), equal.noise = TRUE, opt = c("nlminb", "optim"),
    lower=-Inf, upper=Inf, control=list())
```

Arguments

`formula`	A formula of the form `response ~ x1 + x2 + ...`, where the response specifies the grouping factor (generally a participant's response) and the right hand side specifies the relevant dimensions or features of the stimuli.
`data`	A data frame from which variables specified in `formula` are taken.
`category`	(Optional.) A factor specifying the true category membership of the stimuli.
`par`	object of class `gcjcStruct` or a named list containing a set of initial parameters - that is, `noise` and `bias` (intercepts).
`config`	A numeric value specifying the location of the conjunctive category in relation to the category bounds. The value 1 indicates the category is on the top right (set as default), 2 indicates the top left, 3 indicates bottom left, and 4 indicates the bottom right.
`zlimit`	numeric. The z-scores (or discriminant scores) beyond the specified value will be truncated. Default to `Inf`.
`fixed`	A named list of logical vectors specifying whether each of `noise` and `bias` parameters should be fixed to the initial value. Default to `list(noise=c(FALSE, TRUE), bias=FALSE)`. A fatal error will be returned if set to all `TRUE`.
`equal.noise`	logical. If set to `TRUE` (default), two bounds will have the same noise parameter.
`opt`	A character string specifying the optimizer to be used: either `nlminb` (the default) or `optim`. If "optim", "L-BFGS-B" method is used (see 'Details' of `optim`) .

lower, upper	Bounds on the parameters. see 'Details' for default values.
control	A list of control parameters passed to the internal optimization function. See 'Details' of nlminb or optim.

Details

If par is not fully specified in the argument, the function attempts to calculate the initial parameter values based on means by category or by response.

The default lower and upper values are selected based on the range of the data input so that the decision bound is found within the range of the data and convergence can be reached.

Value

object of the class gcjc, i.e., a list containing the following components:

terms	the terms object used.
call	the matched call.
model	the design matrix used to fit the model.
category	the category vector as specified in the input.
initpar	the initial parameter used to fit the model.
par	the fitted parameter.
logLik	the log-likelihood at convergence.

References

Ashby, F. G. (1992) *Multidimensional models of perception and cognition*. Lawrence Erlbaum Associates.

See Also

glc, logLik.gcjc, coef.gcjc, plot.gcjc

Examples

```
data(subjdemo_cj)

m.cj <- gcjc(response ~ x1 + x2, data=subjdemo_cj,
  config=2, category=subjdemo_cj$category, zlimit=7)
```

gcjcStruct *General Conjunctive Classifier structure*

Description

A list of model parameters that specify a conjunctive decision bound, containing `noise`, `coeffs`, and `bias`.

Usage

```
gcjcStruct(noise, bias, config=c(1,2,3,4))
```

Arguments

`noise`	a positive non-zero numeric.
`bias`	numeric vector corresponding to the intercepts of the bounds
`config`	A numeric value specifying the location of the conjunctive category in relation to the category bounds. The value 1 indicates the category is on the top right (set as default), 2 indicates the top left, 3 indicates bottom left, and 4 indicates the bottom right.

Value

object of class `gcjcStruct`, which is a list of a named list containing `noise`, `coeffs`, and `bias`.

See Also

`gcjc`, `coef.glcStruct`, `logLik.glcStruct`

Examples

```
params <- gcjcStruct(noise=10, bias=c(100, 200), config=1)
```

glc *General Linear Classifier*

Description

Fit a general linear classifier (a.k.a. linear decison-bound model).

Usage

```
glc(formula, data, category, par = list(), zlimit = Inf,
    covstruct=c("unstructured", "scaledIdentity", "diagonal", "identity"),
    fixed = list(), opt = c("nlminb", "optim"),
    lower=-Inf, upper=Inf, control=list())
```

Arguments

formula	A formula of the form response ~ x1 + x2 + ..., where the response specifies the grouping factor (generally a participant's response) and the right hand side specifies the relevant dimensions or features of the stimuli.
data	A data frame from which variables specified in formula are taken.
category	(Optional.) A factor specifying the true category membership of the stimuli.
par	object of class glcStruct or named list containing a set of initial parameters (i.e., noise, coeffs, bias) used to fit the data.
zlimit	numeric. The z-scores (or discriminant scores) beyond the specified value will be truncated. Default to Inf.
covstruct	An optional character string. Only used when the initial parameters are not fully specified. see ldb.
fixed	A named list of logical vectors specifying whether each of noise, coeffs, and bias parameters should be fixed to the initial value. Default to list(noise=FALSE, coeffs=FALSE, bia A fatal error will be returned if set to all TRUE.
opt	A character string specifying the optimizer to be used: either nlminb (the default) or optim. If "optim", "L-BFGS-B" method is used (see 'Details' of optim) .
lower, upper	Bounds on the parameters. see 'Details' for default values.
control	A list of control parameters passed to the internal optimization function. See 'Details' of nlminb or optim.

Details

If par is not fully specified in the argument, the function attempts to calculate the initial parameter values by internally calling the functions mcovs and ldb. If category is also not specified, the response specified in the formula is used as the grouping factor in mcovs.

The default lower and upper values vary depending on the dimension of the model (i.e., the number of variables in the right hand side of formula). In all cases, default lower and upper values for the noise parameter is .001 and 500 respectively. In cases when an one-dimensional model is fitted, lower and upper bounds for the bias parameters are selected based on the range of the data input so that the decision bound is found within the reasonable range of the data and convergence can be reached. In all other cases, coeffs and bias has no limits.

When an one-dimensional model is being fit, fixed$coeffs always becomes TRUE.

Value

object of the class glc, i.e., a list containing the following components:

terms	the terms object used.
call	the matched call.
model	the design matrix used to fit the model.
category	the category vector as specified in the input.
initpar	the initial parameter used to fit the model.
par	the fitted parameter.
logLik	the log-likelihood at convergence.

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

Ashby, F. G., & Gott, R. E. (1988). *Decision rules in the perception and categorization of multidimensional stimuli*. Journal of Experimental Psychology: Learning, Memory, & Cognition, 14, 33-53.

Ashby, F. G. (1992) *Multidimensional models of perception and cognition*. Lawrence Erlbaum Associates.

See Also

gqc, ldb, logLik.glc, coef.glc, predict.glc, scale.glc, plot.glc, plot3d.glc

Examples

```
data(subjdemo_2d)
d2 <- subjdemo_2d
#fit a 2d suboptimal model
fit.2dl <- glc(response ~ x + y, data=d2, category=d2$category, zlimit=7)
#fit a 1d model (on the dimention 'y') on the same dataset
fit.1dy <- glc(response ~ y, data=d2, category=d2$category, zlimit=7)
#or using update()
#fit.1dy <- update(fit.2dl, . ~ . -x)

#fit a 2d optimal model
fit.2dlopt <- glc(response ~ x + y, data=d2, category=d2$category, zlimit=7,
    fixed=list(coeffs=TRUE, bias=TRUE))

#calculate AIC and compare
AIC(fit.2dl, fit.1dy, fit.2dlopt)
```

---

glcStruct *General Linear Classifier structure*

Description

A named list of model parameters that specify a linear decision bound, containing `noise`, `coeffs`, and `bias`.

Usage

```
glcStruct(noise, coeffs, bias)
```

Arguments

`noise`	a positive non-zero numeric.
`coeffs`	vector. the length of the `coeffs` should correspond to the number of the model's dimension.
`bias`	numeric.

Value

object of class `glcStruct`, i.e., a named list containing `noise`, `coeffs`, and `bias`. Returned values are normalized, such that each value are divided by the euclidean norm of the `coeffs` vector, and the sum of `coeffs^2` is 1.

See Also

`glc`, `coef.glcStruct`, `logLik.glcStruct`, `old2new_par`, `new2old_par`

Examples

```
params <- glcStruct(noise=10, coeffs=c(1, -1), bias=0)
```

---

gqc *General Quadratic Classifier*

Description

Fit a general quadratic classifier (a.k.a. quadratic decison-bound model).

Usage

```
gqc(formula,
    data,
    category,
    par = list(),
    zlimit = Inf,
    fixed = list(),
    opt = c("nlminb", "optim"),
    lower=-Inf,
    upper=Inf,
    control=list())
```

Arguments

`formula`	A formula of the form `response ~ x1 + x2 + ...` where the response specifies the grouping factor (generally a participant's response) and the right hand side specifies the feature values of the classified stimuli.
`data`	A data frame from which variables specified in `formula` are taken.
`category`	(Optional.) A factor specifying the true category membership of the stimuli.
`par`	object of class `gqcStruct` or named list containing a set of initial parameters used to fit the data.
`zlimit`	numeric. The z-scores (or discriminant scores) beyond the specified value will be truncated. Default to `Inf`

fixed	A named list of logical vectors specifying whether each of pnoise, cnoise, coeffs, and bias parameters should be fixed to the initial value. Default to all FALSE. A fatal error will result if set to all TRUE.
opt	A character string specifying the optimizer to be used: either nlminb (the default) or optim. If "optim", "L-BFGS-B" method is used (see 'Details' of optim)
lower, upper	Bounds on the parameters. Default values of lower and upper are c(.1, .1, rep(-Inf, length(unlist and c(5000, 5000, rep(Inf, length(unlist(par))-2)), respectively.
control	A list of control parameters passed to the optimizer. See 'Details' of nlminb or optim

Details

If par is not fully specified in the argument, the function attempts to calculate the initial parameter values by internally calling the functions mcovs and qdb. The response specified in the formula is used as the grouping factor in mcovs.

Value

object of class gqc, i.e., a list containing the following components:

terms	the terms object used.
call	the matched call.
model	the design matrix used to fit the model.
category	the category vector as specified in the input.
initpar	the initial parameter used to fit the model.
par	the fitted parameter.
logLik	the log-likelihood at convergence.

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

Ashby, F. G., & Gott, R. E. (1988). *Decision rules in the perception and categorization of multidimensional stimuli*. Journal of Experimental Psychology: Learning, Memory, & Cognition, 14, 33-53.

Ashby, F. G. (1992) *Multidimensional models of perception and cognition*. Lawrence Erlbaum Associates.

See Also

glc, qdb, logLik.gqc, logLik.gqcStruct, plot.gqc, plot3d.gqc

Examples

```
data(subjdemo_2d)
fit.2dq <- gqc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
```

gqcStruct *General Quadratic Classifier structure.*

Description

A named list of model parameters that specify a quadratic decision bound, containing `pnoise`, `cnoise`, `coeffs`, and `bias`.

Usage

```
gqcStruct(pnoise, cnoise, coeffs, bias)
```

Arguments

`pnoise`	a positive non-zero numeric.
`cnoise`	a positive non-zero numeric.
`coeffs`	a vector. The `length(coeffs)` should be equal to `sum(1:(dim+1)) - 1` where `dim` is the number of the model's dimension
`bias`	numeric.

Value

object of class `gqcStruct`, i.e., a named list containing `pnoise`, `cnoise`, `coeffs`, and `bias`.

See Also

`gqc`, `logLik.gqcStruct`

Examples

```
params <- gqcStruct(pnoise=10, cnoise=100, coeffs=c(1,2,3,4,5), bias=6)
```

grg *General Random Guessing model*

Description

General Random Guessing model

Usage

```
grg(response, fixed = FALSE, k = 2)
```

Arguments

response	A vector containing participant's classification responses.
fixed	logical. If TRUE, Fixed Random Guessing model is fitted. If FALSE, General Random Guessing model is fitted. see 'Details'
k	numeric. the penalty per parameter to be used in calculating AIC. Default to 2.

Details

The function assumes that there are two categories (e.g, 'A' and 'B') to which each stimulus belongs.

Fixed Random Guessing model assumes that participant responded randomly without response bias; for each stimulus, probability of responding 'A' and 'B' is .5. There are no free parameters in this model (i.e., df = 0).

General Random Guessing model assumes that participants responded randomly but is biased toward one response. The model estimates the response bias (df = 1).

Value

object of class grg, which is a list object containing:

par	the fixed or estimated response bias
logLik	the log-likelihood of the model
AIC	Akaike's An Information Criterion for the fitted model

References

Ashby, F. G., & Crossley, M. J. (2010). *Interactions between declarative and procedural-learning categorization systems*. Neurobiology of Learning and Memory, 94, 1-12.

See Also

glc, gqc, extractAIC.grg

Examples

```
data(subjdemo_2d)
fit.grand <- grg(subjdemo_2d$response, fixed=FALSE)

fit.frand <- grg(subjdemo_2d$response, fixed=TRUE)
```

`grtMeans` *Obtain means of two multivariate normal populations satisfying certain criteria*

Description

Obtain means of two multivariate normal populations having the specified covariance structure and centroid, and with which classification based on the optimal decision boundary satisfies the supplied probability of correct classification.

Usage

```
grtMeans(covs, centroid, optldb, p.correct, initd = 5, stepsize = 1)
```

Arguments

`covs`	a matrix or a list of matrices specifying the covariance matrices of the variables. Each matrix should be positive-definite and symmetric.
`centroid`	a vector specifying the center of the two population means
`optldb`	object of class `glcStruct` or a vector of coefficients for the optimal linear decision bound.
`p.correct`	a numeric value between 0 to 1 that specifies the optimal classification performance in terms of probability of correct classification given the decision boundary `optbnd`.
`initd`	numeric. An initial distance between the means of two populations. Default is 5.
`stepsize`	a positive numeric specifying step size to be taken when searching for the means. Default is 1.

Value

`means`	a list of two vectors specifying the means of two populations.
`covs`	a matrix of (averaged) covariance.
`p.correct`	the obtained probability of correct classification.

Author(s)

Author of the original Matlab routine 'Design2dGRTexp': Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

See Also

ldb.p.correct

Examples

```
foo <- grtMeans(diag(c(625,625)), centroid=c(200, 200*.6),
    optldb=c(.6,-1,0), p.correct=.85)
```

---

grtrnorm *Sample from multiple multivariate normal distributions*

Description

Generate one or more samples from the two or more specified multivariate normal distributions.

Usage

```
grtrnorm(n,
        np = 2,
        means = list(rep(0,np), rep(0,np)),
        covs = diag(rep(1,np)),
        clip.sd = Inf,
        tol = 1e-6,
        empirical = TRUE,
        seed = NULL,
        response.acc = NULL)
```

Arguments

n	the number of samples per population required
np	the number of populations to be sampled from
means	a list of vectors specifying the means of the variable for each populations
covs	a matrix or a list of matrices specifying the covariance matrices of the variables. Each matrix should be positive-definite and symmetric.
clip.sd	an integer specifying the cutoff value of standard score. The standard score of a generated sample exceeding this value should be truncated. Default to Inf (no truncation).
tol	tolerance (relative to largest variance) for numerical lack of positive-definiteness in covs.
empirical	logical. If true, means and covs specify the empirical rather than population means and covariance matrices.
seed	an integer internally supplied as seed argument to the function set.seed. If NULL, .Random.seed is used.
response.acc	an optional numeric value between 0 and 1, specifying the classification accuracy of a hypothetical observer. See 'Details'. Default to NULL.

Details

This function is essentially a wrapper to the `mvrnorm` function in `MASS` package.

If the optional `response.acc` argument is supplied, hypothetical random classification responses with specified accuracy will be generated.

Value

a data frame containing a column of numeric category labels and column(s) of sampled values for each variable, and optionally, a column of hypothetical responses.

Author(s)

Author of the original Matlab routines: Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox.* Behavior Research Methods, 38, 579-583.

Examples

```
m <- list(c(268,157), c(332, 93))
covs <- matrix(c(4538, 4351, 4351, 4538), ncol=2)
II <- grtrnorm(n=80, np=2, means=m, covs=covs)


m <- list(c(283,98),c(317,98),c(283,152),c(317,152))
covs <- diag(75, ncol=2, nrow=2)
CJ <- grtrnorm(n=c(8,16,16,40), np=4, means=m, covs=covs)
CJ$category <- c(1,1,1,2)[CJ$category]
```

---

ldb *Linear Decision Bound*

Description

Find coefficients of the ideal linear decision boundary given the means and covariance of two categories.

Usage

```
ldb(means, covs,
    covstruct = c("unstructured", "scaledIdentity", "diagonal", "identity"),
    noise = 10)
```

Arguments

means	a list of vectors containing means of two distributions.
covs	a matrix or a list of matrix containing the covariance matrix common to the two distributions.
covstruct	character. If "unstructured", the supplied covs is used as-is. If "scaledIdentity", a diagonal covariance matrix with one common variance is used; when the supplied covs has different values on its diagonal, the mean of the diagonal is used. If "diagonal", a diagonal covariance matrix with varying diagonal is used. If "identity", an identity matrix is used. Default to "unstructured"
noise	numeric value. See Details. Default to 10.

Details

The order of vectors in the list means matters as the sign of coeffs and bias in the output will be reversed.

The argument noise is only for convenience; the supplied value is simply bypassed to the output for the subsequent use, i.e., as object of class glcStruct.

Value

The object of class glcStruct

Author(s)

Author of the original Matlab routine 'lindecisbnd': Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

See Also

mcovs, qdb, glcStruct, glc

Examples

```
m <- list(c(187, 142), c(213.4, 97.7))
covs <- diag(c(625, 625))
foo <- ldb(means=m, covs=covs)
```

`ldb.p.correct` *Probability of correct classification based on the optimal linear decision bound.*

Description

Estimates the probability of correct classification under the condition in which the optimal linear decision boundary is used to categorize the samples from two multivariate normal populations with the specified parameters

Usage

```
ldb.p.correct(means, covs, noise = 0)
```

Arguments

`means`	a list of vectors, each specifying the means of a multivariate normal population.
`covs`	a matrix or a list of matrices specifying the covariance matrix of the each multivariate normal population. If a list is given and length(covs) > 2, an unweighted average of the matrices is used.
`noise`	an optional numeric value specifying the noise associated with the decision bound. Default to 0.

Author(s)

Author of the original Matlab routine 'linprobcorr': Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

Examples

```
foo <- grtMeans(diag(c(625,625)), centroid=c(200, 200*.6),
    optldb=c(.6,-1,0), p.correct=.85)
ldb.p.correct(foo$means, foo$covs)
```

`lines.gqcStruct` *lines Method for class 'gqc'*

Description

Add a quadratic decision boundary line through the current plot.

Usage

```
## S3 method for class 'gqcStruct'
lines(x,
    xlim = c(0,1), ylim = c(0,1),
    npoints = 100, col = "black",
    ...)
```

Arguments

`x`	object of class `gqcStruct`
`xlim`	the x limits of the plot. Default to `c(0,1)`
`ylim`	the y limits of the plot. Default to `c(0,1)`
`npoints`	numeric. number of points per dimension used to plot the decision bound. Default is 100.
`col`	the color to be used for the line
`...`	further arguments.

Value

an invisible list of x- and y-coordinates of the line:

`x`	a vector of x-coordinates of the line
`y`	a vector of y-coordinates of the line

See Also

`plot.gqc`, {`plot3d.gqc`}

Examples

```
data(subjdemo_2d)
fit.2dq <- gqc(response ~ x + y, data=subjdemo_2d,
     category=subjdemo_2d$category, zlimit=7)
plot(fit.2dq, fitdb=FALSE, initdb=FALSE)
lines(fit.2dq$par, xlim=c(0,400), ylim=c(0,400), col="red")
lines(fit.2dq$initpar, xlim=c(0,400), ylim=c(0,400), col="blue")
```

logLik.glc *Log-Likelihood of a 'glc' or 'gcjc' Object*

Description

Extract the log-likelihood of the fitted general linear or conjunctive classifier model.

Usage

```
## S3 method for class 'glc'
logLik(object, ...)

## S3 method for class 'gcjc'
logLik(object, ...)
```

Arguments

object	object of class glc or gcjc
...	further arguments (currently unused)

Value

The log-likelihood for the general linear or conjunctive classifier represented by the estimated parameters in object

Note

This function is intended for indirect internal use by functions such as AIC. To obtain the log-likelihood of the fitted model applied to new dataset, use logLik.glcStruct or logLik.gcjcStruct

See Also

glc, logLik.glcStruct, gcjc, logLik.gcjcStruct

Examples

```
data(subjdemo_2d)
fit <- glc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
logLik(fit)
```

logLik.glcStruct *Log-Likelihood of a 'glcStruct' or 'gcjcStruct' Object*

Description

Calculate the log-likelihood of the general linear or conjunctive classifier model applied to a data set.

Usage

```
## S3 method for class 'glcStruct'
logLik(object, response, x, zlimit = Inf, ...)

## S3 method for class 'gcjcStruct'
logLik(object, response, x, zlimit = Inf, ...)
```

Arguments

object	object of class glcStruct or gcjcStruct containing the parameter values at which the log-likelihood is to be evaluated.
response	a vector of classification responses used to calculate the log-likelihood of the model.
x	a matrix or dataframe containing values for each stimulus dimensions.
zlimit	integer. Used to truncate the z-scores whose absolute values are greater than zlimit when calculating the log-likelihood. Default to Inf
...	further arguments (currently unused)

Value

The log-likelihood for the general linear or conjunctive classifier described by object fitted against the dataset given by response and x.

Note

The value of attributes, attr(, "df") (degrees of freedom) is calculated based on the assumption that all the parameters in object are free to vary.

See Also

gqc, gqcStruct, logLik.glc, logLik.gcjc

Examples

```
m <- list(c(187, 142), c(213, 98))
covs <- diag(625, ncol=2, nrow=2)
db <- ldb(means=m, covs=covs, noise=10)
data(subjdemo_2d)
logLik(db, subjdemo_2d$response, x=subjdemo_2d[2:3], zlimit=7)
```

logLik.gqc *Log-Likelihood of a 'gqc' Object*

Description

Extract the log-likelihood of the fitted general quadratic classifier model.

Usage

```
## S3 method for class 'gqc'
logLik(object, ...)
```

Arguments

object	object of class gqc
...	further arguments (currently unused)

Value

The log-likelihood for the general quadratic classifier represented by the estimated parameters in object

Note

This function is intended for indirect internal use by functions such as AIC. To obtain the log-likelihood of the fitted model applied to new dataset, use logLik.gqcStruct

See Also

gqc, logLik.gqcStruct

logLik.gqcStruct *Log-Likelihood of a 'gqcStruct' Object*

Description

Calculate the log-likelihood of the general quadratic classifier model applied to a data set.

Usage

```
## S3 method for class 'gqcStruct'
logLik(object, response, x, zlimit = Inf, ...)
```

Arguments

object	object of class gqcStruct
response	a vector of classification responses used to calculate the log-likelihood of the gqc model.
x	a matrix or dataframe containing values for each stimulus dimensions.
zlimit	integer. Used to truncate the z-scores whose absolute values are greater than zlimit when calculating the log-likelihood. Default to Inf
...	further arguments (currently unused)

Value

The log-likelihood for the general quadratic classifier described by object fitted against the dataset given by response and x.

Note

The value of attributes, attr(, "df") (degrees of freedom) is calculated based on the assumption that all the parameters in object are free to vary.

See Also

gqc, gqcStruct, logLik.gqc

Examples

```
m <- list(c(187, 142), c(213, 98))
covs <- list(diag(625, ncol=2, nrow=2), diag(600, ncol=2, nrow=2))
db <- qdb(means=m, covs=covs)
data(subjdemo_2d)
logLik(db, subjdemo_2d$response, x=subjdemo_2d[2:3], zlimit=7)
```

---

mcovs *Calculate sample means and covariance(s) of multivariate data*

Description

Calculate sample means and covariance(s) of multivariate data

Usage

```
## Default S3 method:
mcovs(x, grouping, pooled=TRUE, ...)

## S3 method for class 'formula'
mcovs(formula, data, pooled=TRUE, ...)
```

Arguments

formula	A formula in the form of grouping ~ x1 + x2 + ..., where the right hand side specifies the sample variables.
data	Data frame from which variables specified in formula are taken.
x	data frame or Matrix containing sample values.
grouping	a factor specifying the population to which the samples in x belong.
pooled	logical. If TRUE, pooled variance-covariance matrix is calculated. If FALSE, a list of variance-covariance matrices for each groups are calculated. Default to TRUE.
...	further arguments

Value

A list containing:

N	total number of samples.
counts	number of samples per groups.
lev	levels of the grouping factor
means	a named list of vectors specifying the means for each group. Named according to lev.
covs	a named list of variance-covarinace matrix(es). Named as pooled if pooled=TRUE, otherwise according to lev.

---

new2old_par *Convert 'new' to 'old' glcStruct format*

Description

Converts the glcStruct in 'new' format to 'old' format whereby a vector of angle is converted to coeffs.

Usage

```
new2old_par(x)

angle2cart(angle)
```

Arguments

x	object of class glcStruct.
angle	vector.

Value

For new2old_par, object of class glcStruct.

For angle2cart, vector.

Author(s)

Author of the original Matlab routines: Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

See Also

old2new_par cart2angle glcStruct

Examples

```
m <- list(c(187, 142), c(213.4, 97.7))
covs <- diag(c(625, 625))
foo <- ldb(means=m, covs=covs)
bar <- old2new_par(foo)
new2old_par(bar)

angle2cart(bar$angle)
```

---

old2new_par *Convert 'old' to 'new' glcStruct format*

Description

Converts glcStruct in the 'old' to 'new' format for more efficient optimization where coeffs vectors are converted to a vector of angle with length of (coeffs) - 1

Usage

```
old2new_par(x)

cart2angle(cart)
```

Arguments

x	object of class glcStruct.
cart	vector.

Value

For `old2new_par`, object of class `glcStruct`.

For `cart2angle`, vector.

Author(s)

Author of the original Matlab routines: Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox.* Behavior Research Methods, 38, 579-583.

Examples

```
m <- list(c(187, 142), c(213.4, 97.7))
covs <- diag(c(625, 625))
foo <- ldb(means=m, covs=covs)
old2new_par(foo)

cart2angle(foo$coeffs)
```

`plot.gcjc` *Plot Method for Class 'gcjc'*

Description

Plot the fitted data set and decision boundary.

Usage

```
## S3 method for class 'gcjc'
plot(x, fitdb = TRUE, initdb = FALSE, xlim = NULL, ylim = NULL, bg, pch, ...)
```

Arguments

`x`	object of class `gcjc`
`fitdb`	logical. If `TRUE`, the fitted decision bound is plotted. Default to `TRUE`
`initdb`	logical. If `TRUE`, the decision bound specified by the initial parameters is plotted. Default to `FALSE`
`xlim`	the x limits of the plot
`ylim`	the y limits of the plot
`bg`	the background color to be used for points. Default is `c("white","gray")[response]` where `response` represents the response vector of the model
`pch`	the symbols to be used as points. Default is `c(21,24)[x$category]`
`...`	further arguments.

Details

This function produces a scatter plot of data matrix in the x and (optionally) decision boundary specified within (i.e., x$par and/or x$initpar).

Examples

```
m <- list(c(100,200),c(100,100),c(200,100),c(200,200))
covs <- diag(30^2, ncol=2, nrow=2)
set.seed(1)
CJ <- grtrnorm(n=c(50,20,10,20), np=4, means=m, covs=covs)
CJ$category <- c(1,2,2,2)[CJ$category]
#create ramdom responses with 80% accuracy
CJ$response <- CJ$category
set.seed(1)
incorrect <- sample(1:100, size=20)
CJ$response[incorrect] <- abs(CJ$response[incorrect] - 3)

#now fit the model
m.cj <- gcjc(response ~ x1 + x2, data=CJ, config=2, category=CJ$category, zlimit=7)

plot(m.cj)
```

---

plot.glc *Plot Method for Class 'glc'*

Description

Plot the fitted data set and linear decision boundary.

Usage

```
## S3 method for class 'glc'
plot(x, fitdb = TRUE, initdb = FALSE, xlim = NULL, ylim = NULL, bg, pch, ...)
```

Arguments

x	object of class glc
fitdb	logical. If TRUE, the fitted decision bound is plotted. Default to TRUE
initdb	logical. If TRUE, the decision bound specified by the initial parameters is plotted. Default to FALSE
xlim	the x limits of the plot
ylim	the y limits of the plot
bg	the background color to be used for points. Default is c("white","gray")[response] where response represents the response vector of the model
pch	the symbols to be used as points. Default is c(21,24)[x$category]
...	further arguments.

Details

This function produces a scatter plot of data matrix in the `x` and (optionally) decision boundary specified within (i.e., `x$par` and/or `x$initpar`).

The look of the plot differs depending on the dimension of the model. If the dimension is 1, the model matrix is plotted on the y-axis, and category vector (as in `x$category`) is plotted on the x axis. If the dimension is 2, scatter plot of the model matrix is plotted. If the dimension is 3, `plot3d.glc` is called to create a 3D scatter plot. If the dimension is greater than 3, an error message will be returned.

See Also

`plot3d.glc`

Examples

```
data(subjdemo_2d)
fit.2dl <- glc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
plot(fit.2dl)

#if one wants to plot decision bounds in
# colors different from the defaults
plot(fit.2dl, fitdb=FALSE)
abline(coef=coef(fit.2dl$par), col="orange")
abline(coef=coef(fit.2dl$initpar), col="purple")
```

---

plot.gqc *plot Method for Class 'gqc'*

Description

Plot the fitted data set and quadratic decision boundary.

Usage

```
## S3 method for class 'gqc'
plot(x, fitdb = TRUE, initdb = FALSE,
    xlim = NULL, ylim = NULL, bg, pch, npoints = 100, ...)
```

Arguments

`x`	object of class `gqc`
`fitdb`	logical. If `TRUE`, the fitted decision bound will be plotted. Default to `TRUE`.
`initdb`	logical. If `TRUE`, the decision bound specified by the initial parameters will be plotted. Default to `FALSE`.

xlim	the x limits of the plot. If NULL, limits are calculated from the model matrix. Default to NULL.
ylim	the y limits of the plot. If NULL, limits are calculated from the model matrix. Default to NULL.
bg	the background color to be used for points in 2D scatter plot. Default is c("white", "gray")[response] where response represents the response vector of the model
pch	the symbols to be used as points in 2D scatter plot. Default is c(21,24)[x$category]
npoints	number of points per dimension used to plot the decision bound. Default is 100.
...	further arguments.

Details

This function produces a scatter plot of data matrix in the x and (optionally) decision boundary (i.e., x$par and/or x$initpar).

The look of the plot differs depending on the dimension of the model. If the dimension is 2, scatter plot of the model matrix is plotted. If the dimension is 3, plot3d.gqc is called to create a 3D scatter plot. In all other cases, an error message will be returned.

See Also

lines.gqcStruct, {plot3d.gqc}

Examples

```
data(subjdemo_2d)
fit.2dq <- gqc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
plot(fit.2dq)
```

---

plot3d.glc *plot3d Method for Class 'glc'*

Description

plot the fitted 3D data set and linear decision boundary.

Usage

```
## S3 method for class 'glc'
plot3d(x, fitdb = TRUE, initdb = FALSE,
    lims = NULL, alpha = .5, ...)
```

Arguments

x	object of class glc
fitdb	logical. If TRUE, the fitted decision bound will be plotted. Default to TRUE
initdb	logical. If TRUE, the decision bound specified by the initial parameters will be plotted. Default to FALSE
lims	column matrix of the x, y, and z limits of the plot
alpha	alpha value for the decision bound surface(s) ranging from 0 (fully transparent) to 1 (opaque). Default is .5.
...	further arguments.

Details

This function produces a 3D scatter plot of data matrix in the x and (optionally) decision boundary specified within (i.e., x$par and/or x$initpar), using points3d and quads3d in the rgl package respectively.

References

Daniel Adler, Oleg Nenadic and Walter Zucchini (2003) RGL: A R-library for 3D visualization with OpenGL

See Also

plot.glc, plot3d.gqc

Examples

```
data(subjdemo_3d)
fit.3dl <- glc(response ~ x + y + z, data=subjdemo_3d,
    category=subjdemo_3d$category, zlimit=7)
plot3d(fit.3dl)
```

---

plot3d.gqc *plot3d Method for Class 'gqc'*

Description

plot the fitted 3D data set and quadratic decision boundaries.

Usage

```
## S3 method for class 'gqc'
plot3d(x, fitdb = TRUE, initdb = FALSE,
    lims = NULL, npoints = 100, alpha = .5,
    fill = TRUE, smooth = FALSE, ...)
```

Arguments

x	object of class gqc
fitdb	logical. If TRUE, the fitted decision bound will be plotted. Default to TRUE
initdb	logical. If TRUE, the decision bound specified by the initial parameters will be plotted. Default to FALSE
lims	column matrix of the x, y, and z limits of the plot. If NULL, limits are calculated from the model matrix of x. Default to NULL.
npoints	number of points per dimension (i.e., x, y, and z) used to plot the decision bound surface. Default is 100.
alpha	alpha value for the decision bound surface(s) ranging from 0 (fully transparent) to 1 (opaque). Default is .5
fill	logical. If TRUE, decision bounds (if fitdb or initdb is set to TRUE) should be drawn with filled surfaces. If FALSE, a wire frame should be used. Default to TRUE.
smooth	logical. If TRUE, smooth shading should be used. Default to FALSE.
...	further arguments.

Details

This function produces a 3D scatter plot of data matrix of x and (optionally) quadratic decision boundaries specified within (i.e., x$par and/or x$initpar), using points3d function in the rgl package and contour3d function in the misc3d package respectively.

References

Daniel Adler, Oleg Nenadic and Walter Zucchini (2003) RGL: A R-library for 3D visualization with OpenGL

See Also

plot.gqc, {plot3d.gqc}

Examples

```
data(subjdemo_3d)
fit.3dq <- gqc(response ~ x + y + z, data=subjdemo_3d,
    category=subjdemo_3d$category, zlimit=7)
plot3d(fit.3dq)
```

`predict.glc` *predict method for General Linear Classifier*

Description

Predicted classification based on 'glc' model object.

Usage

```
## S3 method for class 'glc'
predict(object, newdata, seed = NULL, ...)
```

Arguments

`object`	object of class `glc`.
`newdata`	a vector or a matrix containing new samples with which the classification prediction is to be made.
`seed`	numeric. The 'seed' used for the random number generator.
`...`	further arguments (currently unused).

Details

The function predict (or 'simulate') classification response of an observer whose noise and linear decision bounds are specified in `object`.

The predicted category labels are matched with those used for the fit in `object`.

If `newdata` is missing, the predictions are made on the data used for the fit.

Value

a vector of labels of categories to which each sample in `newdata` is predicted to belong, according to the model in `object`.

Author(s)

Author of the original Matlab routines: Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

Examples

```
data(subjdemo_2d)
fit.2dl <- glc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)

m <- list(c(187, 142), c(213.4, 97.7))
covs <- diag(c(900, 900))
newd <- grtrnorm(n=20, np=2, means=m, covs=covs, seed=1234)
predict(fit.2dl, newd[,2:3], seed=1234)
```

---

qdb *Quadratic Decision Bound*

Description

Find coefficients of the ideal quadratic decision boundary given the means and covariance of two categories.

Usage

```
qdb(means, covs, pnoise = 10, cnoise = 100, sphere = FALSE)
```

Arguments

means	a list of vectors containing means of the two distributions.
covs	a list containing the covariance matrices of the two distributions.
pnoise, cnoise	numeric. Defaults set to 10, and 100, respectively. see 'Details'
sphere	logical. If TRUE, the returned decison bound forms a circle or sphere.

Details

The order of vectors in the list means and covs matters as the sign of coeffs and bias object in the output will be reversed.

The argument pnoise and cnoise is only for convenience; the supplied value is simply bypassed to the output for the subsequent use, i.e., as object of class gqcStruct.

Value

object of class gqcStruct

Author(s)

Author of the original Matlab routine 'quaddecisbnd': Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

See Also

mcovs, qdb, gqcStruct, gqc

Examples

```
m <- list(c(187, 142), c(213.4, 97.7))
covs <- list(diag(c(625, 625)), diag(c(625, 625)))
foo <- qdb(means=m, covs=covs)
```

---

qdb.p.correct *the proportion correct of the quadratic decision boundary.*

Description

Calculate the proportion correct obtained by categorizing samples form one multivariate normal population using the quadratic decision boundary.

Usage

```
qdb.p.correct(x, qdb, refpts = colMeans(x))
```

Arguments

x	a vector or matrix containing the values of samples from one multivariate normal population.
qdb	object of class gqcStruct or a vector containing the values for coeffs and bias of an quadratic decision bound.
refpts	a numeric vector used as a reference point to determine the correct side of the qdb for classifying x. The length(refpts) should be equal to ncol(x). Default to colMeans(x).

Details

The function assumes that all the points specified in x belong to just one category.

Author(s)

Author of the original Matlab routine 'quadbndpercorr': Leola Alfonso-Reese

Author of R adaptation: Kazunaga Matsuki

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

Examples

```
data(subjdemo_2d)
tmp <- split(subjdemo_2d, subjdemo_2d$category)
mc <- mcovs(category ~ x + y, data=subjdemo_2d, pooled=FALSE)
db <- qdb(mc$means, mc$covs)
qdb.p.correct(tmp[[1]][,2:3], db)
```

---

scale *Scale method for the class 'glc' and 'gqc'*

Description

Return the discriminant scores obtained by applying the general linear classifier to the fitted data.

Usage

```
## S3 method for class 'glc'
scale(x, initdb = FALSE, zlimit = Inf, ...)
## S3 method for class 'gqc'
scale(x, initdb = FALSE, zlimit = Inf, ...)
```

Arguments

x	object of class glc or gqc
initdb	optional logical. If TRUE, the returned vector represents the z-scores with respect to the initial parameters, rather than the fitted parameters. Defaults to FALSE.
zlimit	optional numeric. Used to truncate the scores beyond the speficied value. Default to Inf
...	further arguments (currently unused)

Note

The generic function scale is redefined to accept arguments other than x, center, and scale.

Examples

```
data(subjdemo_2d)
fit.2dl <- glc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
scale(fit.2dl)
```

```
fit.2dq <- gqc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
scale(fit.2dq)


## Not run:
#plots using the discriminant scores
require(Hmisc)
options(digits=3)
fit.2dl <- glc(response ~ x + y, data=subjdemo_2d,
    category=subjdemo_2d$category, zlimit=7)
# z-scores based on the initial decision bound
# split by the true category membership
zinit <- split(scale(fit.2dl, initdb=TRUE), subjdemo_2d$category)
histbackback(zinit)

# z-scores based on the fitted decision bound
# split by the participants' response
zfit1 <- split(scale(fit.2dl, initdb=FALSE), subjdemo_2d$category)
histbackback(zfit1)

# z-scores based on the fitted decision bound
# split by the true category membership
zfit2 <- split(scale(fit.2dl, initdb=FALSE), subjdemo_2d$response)
histbackback(zfit2)

## End(Not run)
```

`subjdemo_1d` *Sample dataset of a categorization experiment with 1D stimuli.*

Description

A sample one dimensional stimulus set and response data of a hypothetical participant in a two-category classification experiment involving 500 trials.

Usage

```
subjdemo_1d
```

Format

This data frame contains 500 rows and the following columns:

`category` label of the category to which each stimulus belongs.

`x` value on the dimension 'x'

`response` classification response of a participant.

Source

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

`subjdemo_2d` *Sample dataset of a categorization experiment with 2D stimuli.*

Description

A sample two dimensional stimulus set and response data of a hypothetical participant in a two-category classification experiment involving 500 trials.

Usage

```
subjdemo_2d
```

Format

This data frame contains 500 rows and the following columns:

`category` label of the category to which each stimulus belongs.

`x` value on the dimension 'x'

`y` value on the dimension 'y'

`response` classification response of a participant.

Source

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox*. Behavior Research Methods, 38, 579-583.

subjdemo_3d — *Sample dataset of a categorization experiment with 3D stimuli.*

Description

A sample one dimensional stimulus set and response data of a hypothetical participant in a two-category classification experiment involving 500 trials.

Usage

```
subjdemo_3d
```

Format

This data frame contains 500 rows and the following columns:

`category` label of the category to which each stimulus belongs.

`x` value on the dimension 'x'

`y` value on the dimension 'y'

`z` value on the dimension 'z'

`response` classification response of a participant.

Source

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox.* Behavior Research Methods, 38, 579-583.

References

Alfonso-Reese, L. A. (2006) *General recognition theory of categorization: A MATLAB toolbox.* Behavior Research Methods, 38, 579-583.

subjdemo_cj — *Sample dataset of a categorization experiment with 2D conjunctive stimuli.*

Description

A sample two dimensional stimulus set and response data of a hypothetical participant in a two-category classification experiment involving 100 trials.

Usage

```
subjdemo_cj
```

Format

This data frame contains 100 rows and the following columns:

`category` label of the category to which each stimulus belongs.

`x1` value on the dimension 'x1'

`x2` value on the dimension 'x2'

`response` classification response of a participant.

Examples

```
##### the data was generated using following codes:
m <- list(c(100,200),c(100,100),c(200,100),c(200,200))
covs <- diag(30^2, ncol=2, nrow=2)
set.seed(1)
subjdemo_cj <- grtrnorm(n=c(50,20,10,20), np=4, means=m, covs=covs)
subjdemo_cj$category <- c(1,2,2,2)[subjdemo_cj$category]
##### create ramdom responses with 80% accuracy
subjdemo_cj$response <- subjdemo_cj$category
set.seed(1)
incorrect <- sample(1:100, size=20)
subjdemo_cj$response[incorrect] <- abs(subjdemo_cj$response[incorrect] - 3)

##### plotting the dataset
with(subjdemo_cj, plot(x2 ~ x1, bg=category, pch=response))
abline(h=150, lty=2)
abline(v=150, lty=2)
```

---

unscale *Un-scale or re-center the scaled or centered Matrix-like object*

Description

This function revert a Matrix-like object that is scaled or centered via `scale.default` to data with the original scale/center.

Usage

```
unscale(x)
```

Arguments

`x`	numeric matrix(like object).

Value

a matrix that are re-centered or un-scaled, based on the value of attributes "scaled:center" and "scaled:scale" of `x`. If neither of those attributes is specified, `x` is returned.

See Also

scale

Examples

```
require(stats)
x <- matrix(1:10, ncol=2)
unscale(z <- scale(x))

#maybe useful for truncating
trunc <- 1
z[abs(z) > trunc] <- sign(z[abs(z) > trunc])*trunc
unscale(z)
```

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