

Package ‘R2MLwiN’

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Suggests doBy, car, lmtest, mitools, reshape

Description An R command interface to the 'MLwiN' multilevel
modelling software package.

License GPL (>= 2)

URL <http://www.bristol.ac.uk/cmm/software/r2mlwin/>,<https://r-forge.r-project.org/projects/r2mlwin/>,<http://www.bristol.ac.uk/cmm/software/mlwin/>

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alevchem

Chemistry A-level results from one exam board

Description

Chemistry A-level results from one exam board; subset from Yang & Woodhouse, 2001. See also Rasbash et al. (2012) and Browne (2012).

Usage

alevchem

Format

A data frame with 2166 observations on the following 8 variables:

lea Local Education Authority ID.

estab Establishment (institution) ID.

pupil Pupil ID.

a_point A-level point score (an ordered factor with levels: F, E, D, C, B, A).

gcse_tot Total GCSE point score.

gcse_no Number of GCSEs taken.

cons Constant of ones

gender Pupil's gender (a factor with levels: male, female).

Details

The alevchem dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009).

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) *A User's Guide to MLwiN Version 2.26*. Centre for Multilevel Modelling, University of Bristol.

Yang, M., Woodhouse, G. (2001) Progress from GCSE to A and AS level: institutional and gender differences, and trends over time. *British Educational Research Journal* 27: 245-267.

Examples

```
## Not run:

data(alevchem, package = "R2MLwiN")

alevchem$gcseav <- alevchem$gcse_tot/alevchem$gcse_no - 6

# Note: Establishment codes on their own do not uniquely identify schools.
# Schools are instead uniquely identified by LEA code, establishment ID
# combination. Thus, here we generated a unique school ID.

alevchem$school <- as.numeric(factor(paste0(alevchem$lea, alevchem$estab)))

(mymodel <- runMLwiN(logit(a_point, cons, 6) ~ 1 + gcseav[1:5] + I(gcseav^2)[1:5] +
  gender[1:5] + (1[1:5] + gcseav[1:5] | school),
  D = "Ordered Multinomial", estoptions = list(EstM = 1), data = alevchem))

## End(Not run)
```

augment.mlwinfitIGLS *Augment data frame with information derived from the model fit (broom package).*

Description

Augment data frame with information derived from the model fit (broom package).

Usage

```
## S3 method for class 'mlwinfitIGLS'
augment(x, data = x@frame, newdata = NULL, type.predict, type.residuals, ...)
```

Arguments

x	An mlwinfitIGLS-class model.
data	original data onto which columns should be added
newdata	new data to predict on, optional
type.predict	Type of prediction to compute
type.residuals	Type of residuals to compute
...	Other arguments.

See Also

[augment](#)

`augment.mlwinfitMCMC` *Augment data frame with information derived from the model fit (broom package).*

Description

Augment data frame with information derived from the model fit (broom package).

Usage

```
## S3 method for class 'mlwinfitMCMC'
augment(x, data = x@data, newdata = NULL, type.predict, type.residuals, ...)
```

Arguments

<code>x</code>	An <code>mlwinfitMCMC-class</code> model.
<code>data</code>	original data onto which columns should be added
<code>newdata</code>	new data to predict on, optional
<code>type.predict</code>	Type of prediction to compute
<code>type.residuals</code>	Type of residuals to compute
<code>...</code>	Other arguments.

See Also

[augment](#)

`bang` *Sub-sample from the 1989 Bangladesh Fertility Survey (see Huq & Cleveland, 1990)*

Description

A subset of data from the 1989 Bangladesh Fertility Survey, consisting of 2867 women across 61 districts.

Usage

`bang`

Format

A data frame with 2867 observations on the following 12 variables:

woman Identifying code for each woman (level 1 unit).

district Identifying code for each district (level 2 unit).

use Contraceptive use status at time of survey; a factor with levels Not_using and Using.

use4 Contraceptive use status and method (a factor with levels: Sterilization, Modern_reversible_method, Traditional_method, Not_using_contraception).

lc Number of living children at time of survey; a factor with ordered levels None, One_child, Two_children, Three_plus.

age Age of woman at time of survey (in years), centred on sample mean of 30 years.

urban Type of region of residence; levels are Rural and Urban.

educ Woman's level of education (a factor with ordered levels None, Lower_primary, Upper_primary, Secondary_and_above).

hindu Woman's religion; levels are Muslim and Hindu.

d_lit Proportion of women in district who are literate.

d_pray Proportion of Muslim women in district who pray every day (a measure of religiosity).

cons Constant of ones.

Details

The bang dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009), and is a subset of data from the 1989 Bangladesh Fertility Survey (Huq and Cleland, 1990) used by Rasbash et al. (2012) as an example when fitting logistic models for binary and binomial responses. The full sample was analysed in Amin et al. (1997).

Source

Amin, S., Diamond, I., Steele, F. (1997) Contraception and religiosity in Bangladesh. In: G. W. Jones, J. C. Caldwell, R. M. Douglas, R. M. D'Souza (eds) *The Continuing Demographic Transition*, 268–289. Oxford: Oxford University Press.

Huq, N. M., Cleland, J. (1990) *Bangladesh fertility survey, 1989*. Dhaka: National Institute of Population Research and Training (NIPORT).

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) *A User's Guide to MLwiN Version 2.26*. Centre for Multilevel Modelling, University of Bristol.

See Also

See m1mRev package for an alternative format of the same dataset, with fewer variables.

Examples

```
## Not run:

data(bang, package = "R2MLwiN")

bang$use4 <- relevel(bang$use4, 4)

# Change contrasts if wish to avoid warning indicating that, by default,
# specified contrasts for ordered predictors will be ignored by runMLwiN
# (they will be fitted as "contr.treatment" regardless of this setting). To
# enable specified contrasts, set allowcontrast to TRUE (this will be the
# default in future package releases).
my_contrasts <- options("contrasts")$contrasts
options(contrasts = c(ordered = "contr.treatment",
                      ordered = "contr.treatment"))

# As an alternative to changing contrasts, can instead use C() to specify
# contrasts for ordered predictors in formula object, e.g.:

# F1 <- log(use4, cons) ~ 1 + C(lc, "contr.treatment") + (1 | district)

# (mymodel <- runMLwiN(Formula = F1,
#                       D = "Unordered Multinomial",
#                       estoptions = list(EstM = 1, nonlinear = c(1, 2)),
#                       data = bang,
#                       allowcontrast = TRUE))

F1 <- log(use4, cons) ~ 1 + lc + (1 | district)

(mymodel <- runMLwiN(Formula = F1,
                    D = "Unordered Multinomial",
                    estoptions = list(EstM = 1, nonlinear = c(1, 2)),
                    data = bang))

# Change contrasts back to pre-existing:
options(contrasts = my_contrasts)

## End(Not run)
```

bang1

Sub-sample from the 1989 Bangladesh Fertility Survey

Description

A subset of data from the 1989 Bangladesh Fertility Survey, consisting of 1934 women across 60 districts.

Usage

bang1

Format

A data frame with 1934 observations on the following 11 variables:

woman Identifying code for each woman (level 1 unit).

district Identifying code for each district (level 2 unit).

use Contraceptive use status at time of survey; a factor with levels Not_using and Using.

lc Number of living children at time of survey; an ordered factor with levels None, One_child, Two_children, Three_plus.

age Age of woman at time of survey (in years), centred on sample mean of 30 years.

urban Type of region of residence; a factor with levels Rural and Urban.

educ Woman's level of education; an ordered factor with levels None, Lower_primary, Upper_primary, Secondary_and_above.

hindu Woman's religion; a factor with levels Muslim and Hindu.

d_illit Proportion of women in district who are literate.

d_pray Proportion of Muslim women in district who pray every day (a measure of religiosity).

cons A column of ones. If included as an explanatory variable in a regression model (e.g. in MLwiN), its coefficient is the intercept.

Details

The bang1 dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009), and is a subset of data from the 1989 Bangladesh Fertility Survey (Huq and Cleland, 1990) used by Browne (2012) as an example when fitting logistic models for binary and binomial responses. The full sample was analysed in Amin et al. (1997).

Source

Amin, S., Diamond, I., Steele, F. (1997) Contraception and religiosity in Bangladesh. In: G. W. Jones, J. C. Caldwell, R. M. Douglas, R. M. D'Souza (eds) *The Continuing Demographic Transition*, 268–289. Oxford: Oxford University Press.

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Huq, N. M., Cleland, J. (1990) *Bangladesh fertility survey, 1989*. Dhaka: National Institute of Population Research and Training (NIPORT).

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

See Also

See m1mRev package for an alternative format of the same dataset, with fewer variables.

Examples

```
## Not run:

data(bang1, package = "R2MLwiN")

bang1$denomb <- 1

# Change contrasts if wish to avoid warning indicating that, by default,
# specified contrasts for ordered predictors will be ignored by runMLwiN
# (they will be fitted as "contr.treatment" regardless of this setting). To
# enable specified contrasts, set allowcontrast to TRUE (this will be the
# default in future package releases).
my_contrasts <- options("contrasts")$contrasts
options(contrasts = c(ordered = "contr.treatment",
                      ordered = "contr.treatment"))

# As an alternative to changing contrasts, can instead use C() to specify
# contrasts for ordered predictors in formula object, e.g.:

# F1 <- logit(use, denomb) ~ 1 + age + C(lc, "contr.treatment") + urban +
#   (1 + urban | district)

# (mymodel <- runMLwiN(Formula = F1,
#                       D = "Binomial",
#                       estoptions = list(EstM = 1),
#                       data = bang1,
#                       allowcontrast = TRUE))

F1 <- logit(use, denomb) ~ 1 + age + lc + urban + (1 + urban | district)

(mymodel <- runMLwiN(Formula = F1,
                    D = "Binomial",
                    estoptions = list(EstM = 1),
                    data = bang1))

# Change contrasts back to pre-existing:
options(contrasts = my_contrasts)

## End(Not run)
```

BD

Calculates Brooks-Draper diagnostic

Description

An internal function, for use in [sixway](#), which calculates the Brooks-Draper diagnostic, based on an unpublished paper by David Draper. It estimates the length of a Markov chain required to produce a mean estimate to k significant figures with a given accuracy (α). See Browne (2012) for further details.

Usage

```
BD(est, var, rho, k = 2, alpha = 0.05)
```

Arguments

est	Numeric scalar for the mean of the distribution
var	Numeric scalar for the variance of the distribution
rho	The first lag (i.e. after zero) of the auto-correlation function (ACF) diagnostic
k	Integer scalar corresponding to the number of significant figures (defaults to 2)
alpha	Numeric scalar indicating the desired accuracy (defaults to 0.05)

Value

The Brooks-Draper diagnostic statistic is returned.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

References

Browne, W.J. (2012) MCMC Estimation in MLwiN, v2.26. Centre for Multilevel Modelling, University of Bristol.

See Also

[sixway](#)

bes83

Subsample from British Election Study, '83.

Description

Subsample from British Election Study, consisting of 800 voters across 110 areas.

Usage

```
bes83
```

Format

A data frame with 800 observations on the following 10 variables:

voter Voter identifier.

area Identifier for voters' constituencies.

defence Score on a 21 point scale of attitudes towards nuclear weapons with low scores indicating disapproval of Britain possessing them. This variable is centred about its mean.

unemp Score on a 21 point scale of attitudes towards unemployment with low scores indicating strong opposition and higher scores indicating a preference for greater unemployment if it results in lower inflation. This variable is centred about its mean.

taxes Score on a 21 point scale of attitudes towards tax cuts with low scores indicating a preference for higher taxes to pay for more government spending. This variable is centred about its mean.

privat Score on a 21 point scale of attitudes towards privatization of public services with low scores indicating opposition. This variable is centred about its mean.

votecons If respondent voted Conservative; a factor with levels Other and Voted_Conservative.

cons This variable is constant (= 1) for all voters.

denom This variable is constant (= 1) for all voters.

Details

The bes83 dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009). See Heath et al (1996), and also Rasbash et al (2012) and Browne (2012).

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Heath, A., Yang, M., Goldstein, H. (1996). Multilevel analysis of the changing relationship between class and party in Britain 1964-1992. *Quality and Quantity*, 30:389-404.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) *A User's Guide to MLwiN Version 2.26*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:
```

```
data(bes83, package = "R2MLwiN")
```

```
(mymodel <- runMLwiN(logit(votecons, cons) ~ 1 + defence + unemp + taxes + privat + (1 | area),
  D = "Binomial", estoptions = list(EstM = 1), data = bes83))
```

```
## End(Not run)
```

caterpillar	<i>Draws a caterpillar plot (in MLwiN style).</i>
-------------	---

Description

A convenient wrapper for the `plot` function with the addition of error bars, e.g. to create caterpillar plots.

Usage

```
caterpillar(  
  y,  
  x,  
  qtlow,  
  qtup,  
  xlab = "",  
  ylab = "",  
  xlim = NULL,  
  ylim = NULL,  
  main = ""  
)
```

Arguments

<code>y</code>	A numerical vector specifying the y coordinates (e.g. the means or medians); see plot.default .
<code>x</code>	A numerical vector specifying the x coordinates; see plot.default .
<code>qtlow</code>	A numerical vector (e.g. of lower-quantiles) to be used to plot lower error bars.
<code>qtup</code>	A numerical vector (e.g. of upper-quantiles) to be used to upper plot error bars.
<code>xlab</code>	A label for the x axis. This is empty by default; see plot.default .
<code>ylab</code>	A label for the y axis. This is empty by default; see plot.default .
<code>xlim</code>	The x limits (<code>x1</code> , <code>x2</code>) of the plot. Note that <code>x1 > x2</code> is allowed and leads to a 'reversed axis'. The default value, <code>NULL</code> , indicates that the range of the finite values to be plotted should be used; see plot.default .
<code>ylim</code>	The y limits of the plot; see plot.default .
<code>main</code>	A main title for the plot; see plot.default .

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol, U.K.

See Also

[caterpillarR](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved where R2MLwiN defaults to:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

# Example using tutorial dataset
data(tutorial, package = 'R2MLwiN')
(mymodel <- runMLwiN(normexam ~ 1 + (1 | school) + (1 | student),
                    estoptions = list(resi.store = TRUE),
                    data = tutorial))

# For each school, calculate the CIs...
residuals <- mymodel@residual$lev_2_resi_est_Intercept
residualsCI <- 1.96 * sqrt(mymodel@residual$lev_2_resi_var_Intercept)
residualsRank <- rank(residuals)
rankno <- order(residualsRank)

caterpillar(y = residuals[rankno], x = 1:65, qtlow = (residuals - residualsCI)[rankno],
            qtup = (residuals + residualsCI)[rankno], xlab = 'Rank', ylab = 'Intercept')

## End(Not run)
```

caterpillarR

Draws caterpillar plots of the residuals from a mlwinfitIGLS-class or mlwinfitMCMC-class object, at a chosen level of the multilevel model.

Description

Uses [qqmath](#) in the **lattice** package to draw Quantile-Quantile plots of the residuals at a chosen level of a multilevel model against a theoretical distribution.

Usage

```
caterpillarR(resi, lev = 2)
```

Arguments

resi	A mlwinfitIGLS-class or mlwinfitMCMC-class object (model must be fitted specifying <code>resi.store = TRUE</code> and including 'variances' or 'sampling' in the list of <code>resioptions</code> (both in <code>estoptions</code>) to not return an error).
lev	An integer scalar specifying the level of a multilevel model for which to produce a plot for.

Value

See [qqmath](#).

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[caterpillar](#), [qqmath](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved where R2MLwiN defaults to:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

# Example using tutorial dataset
data(tutorial, package = 'R2MLwiN')
mymodel <- runMLwiN(normexam ~ 1 + (1 | school) + (1 | student),
                   estoptions = list(resi.store = TRUE),
                   data = tutorial)

# Caterpillar plot
caterpillarR(mymodel['residual'], lev = 2)

## End(Not run)
```

coef,mlwinfitIGLS-method

Extract the coefficient vector from "mlwinfitIGLS" objects

Description

Extract the coefficient vector from "mlwinfitIGLS" objects

Usage

```
## S4 method for signature 'mlwinfitIGLS'
coef(object, ...)
```

Arguments

object	An mlwinfitIGLS-class object
...	Other arguments

See Also[coef-methods](#)

`coef,mlwinfitMCMC-method`*Extract the coefficient vector from "mlwinfitMCMC" objects*

Description

Extract the coefficient vector from "mlwinfitMCMC" objects

Usage

```
## S4 method for signature 'mlwinfitMCMC'
coef(object, ...)
```

Arguments

<code>object</code>	An mlwinfitMCMC-class object
<code>...</code>	Other arguments

See Also[coef-methods](#)

`coef.mlwinfitIGLS`*Extract the coefficient vector from "mlwinfitIGLS" objects*

Description

Extract the coefficient vector from "mlwinfitIGLS" objects

Usage

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

Arguments

<code>object</code>	An mlwinfitIGLS-class object
<code>...</code>	Other arguments

See Also[coef](#)

coef.mlwinfitMCMC	<i>Extract the coefficient vector from "mlwinfitMCMC" objects</i>
-------------------	---

Description

Extract the coefficient vector from "mlwinfitMCMC" objects

Usage

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

Arguments

object	An <code>mlwinfitMCMC</code> -class object
...	Other arguments

See Also

[coef](#)

cvd	<i>Data from the 1998 Scottish Health Survey on cardiovascular disease status of 8804 respondents</i>
-----	---

Description

Data from the 1998 Scottish Health Survey, with 8804 respondents aged between 18 and 64. The outcome, `cvddef`, is a self-report of a doctor-diagnosed cardiovascular disease (CVD) condition (angina, diabetes, hypertension, acute myocardial infarction, etc.). This is a binary response, whether (1) or not (0) respondents have CVD condition.

Usage

```
cvd
```

Format

A data frame with 8804 observations on the following 9 variables:

age Age.

sex Gender (factor with levels: male, female).

sc Social class (factor with levels: 12 (social class 1 and 2), 3 (social class 3), 45 (social class 4 and 5)).

cvddef Self-reported cardiovascular disease (0 = does not have condition, 1 = has condition)

carstair Carstairs score.

smoke Smoking frequency (factor with levels: lite (<10 a day), mod (10-19 a day), hvy (20+ a day), ex (ex-smoker), nevr (never smoked)).

id Respondent identifier.

area Postcode sector

Details

The cvd dataset is one of the example datasets analysed in Leyland and Groenewegen (2020), and provided with the multilevel-modelling software package MLwiN (Charlton et al., 2024), as cvd_data.

Source

Charlton, C., Rasbash, J., Browne, W.J., Healy, M. and Cameron, B. (2024) *MLwiN Version 3.09* Centre for Multilevel Modelling, University of Bristol.

Leyland A.H. (2005) Socioeconomic gradients in the prevalence of cardiovascular disease in Scotland: the roles of composition and context. *J Epidemiol Community Health* 59:799–803

Leyland, A.H., Groenewegen, P.P. (2020). Untangling Context and Composition. In: *Multilevel Modelling for Public Health and Health Services Research*. Springer, Cham. doi:10.1007/9783-030348014_13

Examples

```
## Not run:

data(cvd, package = "R2MLwiN")

# Example taken from Leyland and Groenewegen (2020)

F1 <- logit(cvddef) ~ 1 + I(age^3) + I(age^3):I(log(age)) +
  sex + sex:I(age^3) + sex:I(age^3):I(log(age)) +
  (1 | area)

(mod_MQL1 <- runMLwiN(Formula = F1,
  D = "Binomial",
  data = cvd))

(mod_PQL2 <- runMLwiN(Formula = F1,
  D = "Binomial",
  data = cvd,
  estoptions = list(
    nonlinear = c(N = 1, M = 2),
    startval = list(FP.b = mod_MQL1@FP,
      FP.v = mod_MQL1@FP.cov,
      RP.b = mod_MQL1@RP,
      RP.v = mod_MQL1@RP.cov))))

## End(Not run)
```

deviance.mlwinfitIGLS *Returns the deviance from "mlwinfitIGLS" objects.*

Description

Returns the deviance from "mlwinfitIGLS" objects.

Usage

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

Arguments

object	An mlwinfitIGLS-class object
...	Other arguments

See Also

[deviance](#)

df.residual.mlwinfitIGLS
Returns the residual degrees-of-freedom extracted from "mlwinfit-IGLS" objects.

Description

Returns the residual degrees-of-freedom extracted from "mlwinfitIGLS" objects.

Usage

```
## S3 method for class 'mlwinfitIGLS'
df.residual(object, ...)
```

Arguments

object	An mlwinfitIGLS-class object.
...	Other arguments

See Also

[nobs](#), [coef](#)

df2matrix	<i>Translates a data.frame, formatted for use in multiple membership modelling in MLwiN, to a matrix.</i>
-----------	---

Description

Translates a [data.frame](#), in a form usable by MLwiN for multiple membership models, into a [matrix](#). The data.frame needs to contain (a) columns with membership IDs (e.g. first row of which might be 2, 3, 5, 6, 0, 0) and (b) columns containing weights (e.g. first row of which might be 0.25, 0.25, 0.25, 0.25, 0, 0; in this example the first row of resulting matrix would be 0, 1, 1, 0, 1, 1).

Usage

```
df2matrix(data, idcols, weightcols)
```

Arguments

data	A data.frame object.
idcols	String vector of the identifier column names.
weightcols	String vector of the weight column names.

Value

An adjacency matrix as returned by [sparseMatrix](#).

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol, U.K.

See Also

[matrix2df](#)

diag1	<i>Examination dataset</i>
-------	----------------------------

Description

Examination data for 907 students within 18 schools.

Usage

```
diag1
```

Format

A data frame with 907 observations on the following 9 variables:

school School identifier.

sex Pupil gender.

vrq Verbal Reasoning quotient.

ilea O-level/CSE examination results.

type School type: a factor with levels Comprehensive and Grammar.

pupil Pupil identifier.

cons Constant (=1).

n_ilea O-level/CSE examination results (normal scores).

n_vrq Verbal Reasoning quotient (normal scores).

Details

The `diag1` dataset is one of the sample datasets provided with the multilevel-modelling software package `MLwiN` (Rasbash et al., 2009), originally analysed in Aitkin & Longford (1986), and described further in Rasbash et al. (2012).

Source

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Rasbash, J., Steele, F., Browne, W.J., Goldstein, H. (2012) *A User's Guide to MLwiN v2.26*. University of Bristol: Centre for Multilevel Modelling.

Aitkin, M. & Longford, N. (1986). Statistical modelling in school effectiveness studies (with discussion). *Journal of the Royal Statistical Society, Series A*, 149:1-43.

Examples

```
## Not run:
```

```
data(diag1, package = "R2MLwiN")
```

```
(mymodel <- runMLwiN(n_ilea ~ 1 + n_vrq + (1 + n_vrq | school) + (1 | pupil),
  estoptions = list(resi.store = TRUE, resioptions = c("standardised",
    "leverage", "influence", "deletion")), data = diag1))
```

```
## End(Not run)
```

`double2singlePrecision`*Converts numerical values from double precision to single precision.*

Description

This function converts numeric column(s) of a data frame object, matrix or vector from double precision to single precision, e.g. to avoid a warning from MLwiN which currently only stores data in single precision.

Usage`double2singlePrecision(x)`**Arguments**

`x` A `data.frame` object, matrix or vector to be converted. Column(s) of these objects will be ignored during conversion if they are not numeric.

Value

An object of numerical values in single precision will be returned.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

`extract,mlwinfitIGLS-method`*Extract coefficients and GOF measures from a statistical object (texreg package).*

Description

Extract coefficients and GOF measures from a statistical object (texreg package).

Usage

```
## S4 method for signature 'mlwinfitIGLS'  
extract(  
  model,  
  include.nobs = TRUE,  
  include.loglik = TRUE,  
  include.deviance = TRUE,  
  ...  
)
```

Arguments

model An [mlwinfitIGLS-class](#) model.
 include.nobs should the number of observations be reported?
 include.loglik should the log-likelihood be reported?
 include.deviance
 should the deviance be reported?
 ... Other arguments.

See Also

[extract](#)

extract,mlwinfitMCMC-method

Extract coefficients and GOF measures from a statistical object.

Description

Extract coefficients and GOF measures from a statistical object.

Usage

```
## S4 method for signature 'mlwinfitMCMC'
extract(
  model,
  include.nobs = TRUE,
  include.dbar = TRUE,
  include.dthetabar = TRUE,
  include.pd = TRUE,
  include.dic = TRUE,
  ...
)
```

Arguments

model An [mlwinfitMCMC-class](#) model.
 include.nobs should the number of observations be reported?
 include.dbar should the Dbar be reported?
 include.dthetabar
 should the D(thetabar) be reported?
 include.pd should the pD be reported?
 include.dic should the DIC be reported?
 ... Other arguments.

See Also

[extract](#)

fitted.mlwinfitIGLS *Returns the fitted values from "mlwinfitIGLS" objects.*

Description

Returns the fitted values from "mlwinfitIGLS" objects.

Usage

```
## S3 method for class 'mlwinfitIGLS'  
fitted(object, ...)
```

Arguments

object An `mlwinfitIGLS`-class object.
... Other arguments.

See Also

[fitted.values](#)

fitted.mlwinfitMCMC *Returns the fitted values from "mlwinfitMCMC" objects.*

Description

Returns the fitted values from "mlwinfitMCMC" objects.

Usage

```
## S3 method for class 'mlwinfitMCMC'  
fitted(object, ...)
```

Arguments

object An `mlwinfitMCMC`-class object.
... Other arguments

See Also

[fitted.values](#)

formula.mlwinfitIGLS *"mlwinfitIGLS" model formula*

Description

"mlwinfitIGLS" model formula

Usage

```
## S3 method for class 'mlwinfitIGLS'  
formula(x, env = parent.frame(), ...)
```

Arguments

x	See formula
env	See formula
...	Other arguments; see formula

formula.mlwinfitMCMC *"mlwinfitMCMC" model formula*

Description

"mlwinfitMCMC" model formula

Usage

```
## S3 method for class 'mlwinfitMCMC'  
formula(x, env = parent.frame(), ...)
```

Arguments

x	See formula
env	See formula
...	Other arguments; see formula

Formula.translate *An internal function to translate an R formula into an R list object.*

Description

A model formula, as a formula object written in R-type syntax, is translated into an R list object.

Usage

```
Formula.translate(Formula, D = "Normal", indata)
```

Arguments

Formula	A formula object specifying a multilevel model. See formula for notes on general usage, and runMLwiN for further details.
D	A character string/vector specifying the type of distribution to be modelled, which can include 'Normal' (the default), 'Binomial', 'Poisson', 'Negbinom', 'Unordered Multinomial', 'Ordered Multinomial', 'Multivariate Normal', or 'Mixed'. In the case of the latter, 'Mixed' precedes the response types which also need to be listed in D, e.g. <code>c('Mixed', 'Normal', 'Binomial')</code> ; these need to be listed in the same order to which they are referred to in the Formula object.
indata	A data.frame object containing the data to be modelled. Optional (can attach as an alternative) but recommended.

Value

Outputs an R list object, which is then used as the input for [write.IGLS](#) or [write.MCMC](#).

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[runMLwiN](#), [write.IGLS](#), [write.MCMC](#); for function allowing back-compatibility with Formula syntax used in older versions of **R2MLwiN** (<0.8.0) see [Formula.translate.compat](#).

Examples

```
## Not run:
# NB: See demo(packge = 'R2MLwiN') for a wider range of examples.
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')
```

```

# Two-level random intercept model with student (level 1) nested within
# school (level 2) and standlrt added to the fixed part.
# Importantly, the ordering of school and student reflects their hierarchy,
# with the highest level (school) specified first.
# E.g. see demo(UserGuide04)
data(tutorial, package = 'R2MLwiN')
(mymodel1 <- runMLwiN(normexam ~ 1 + standlrt + (1 | school) + (1 | student),
  data = tutorial))

# Adding a random slope
(mymodel2 <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | school)
  + (1 | student), data = tutorial))

# Exploring complex level 1 variation
# E.g. see demo(UserGuide07)
(mymodel3 <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | school)
  + (1 + standlrt | student), data = tutorial))

# Logit link with cons specified as denominator
# Note level 1 ID not explicitly specified
# E.g. see demo(UserGuide09)
data(bang, package = 'R2MLwiN')
(mymodel4 <- runMLwiN(logit(use, cons) ~ 1 + lc + age + (1 | district),
  D = 'Binomial', data = bang))

# Mixed response model
# Note using MCMC estimation (EstM = 1)
# Normal (english) and Bernoulli (behaviour) distributed responses
# probit link modelling behaviour with cons as denominator
# E.g. see demo(MCMCGuide19)
data(jspmix1, package = 'R2MLwiN')
(mymodel <- runMLwiN(c(english, probit(behaviour, cons)) ~
  1 + sex + ravens + fluent[1] + (1 | school) + (1[1] | id),
  D = c('Mixed', 'Normal', 'Binomial'),
  estoptions = list(EstM = 1,
  mcmcMeth = list(fixM = 1, residM = 1, Lev1VarM = 1)),
  data = jspmix1))

## End(Not run)

```

Formula.translate.compat

An internal function, allowing back-compatibility, which translates a model formula from a formula object or character string into an R list object.

Description

Supports Formula syntax as used in earlier (<0.8-0) versions of **R2MLwiN**. A model formula, as a formula object (or a character string) is translated into an R list object. Called by `runMLwiN` if `oldsyntax = TRUE` (when user specifies `levID` not `NULL` in `runMLwiN` function call). For corresponding function supporting new syntax, see [Formula.translate](#).

Usage

```
Formula.translate.compat(Formula, levID, D = "Normal", indata)
```

Arguments

Formula	A formula object (or a character string) specifying a multilevel model. See Value for details.
levID	A character (vector) specifying the level ID(s).
D	A character string/vector specifying the distribution to be modelled, which can include 'Normal' (the default), 'Binomial', 'Poisson', 'Negbinom', 'Unordered Multinomial', 'Ordered Multinomial', 'Multivariate Normal', or 'Mixed'.
indata	A data.frame object containing the data to be modelled.

Details

If Formula is a character string, then the following syntax applies:

- `~` A tilde is used to separate response variable(s) and explanatory variable(s).
- `()` Round brackets are used to specify each random variable in the model together with its fixed/random part information.
- `|` Separates explanatory variable(s) (placed to the right of `|`) from the fixed/random part information (placed to the left of `|`) when placed within `()`.
- `[]` When placed immediately after an explanatory variable, indicates that the variable is categorical. The string in the `[]` represents the reference category; if empty, no reference category is used; See note.
- `:` Indicates an interaction term: i.e. the variables adjacent to `:`, and separated by it, are interacted with each other.
- `∅` When placed to the left of `|` within `()` indicates that the variables to the right of `|` within the same `()` are to be added to the fixed part of the model.
- `1` When placed to the left of `|` within `()` indicates that the coefficients of the variables placed to the right of `|` within the same `()` are to be allowed to randomly vary at level 1 (and so on for 2 for level 2, 3 for level 3, etc.)
- `∅s/∅c` When placed to the left of `|` within `()` indicates that separate (hence `s`) / common (hence `c`) coefficients for the variables to the right of `|` within the same `()` are to be added to the fixed part (hence `∅`) of multivariate normal, multinomial and mixed responses models.
- `2s/2c` When placed to the left of `|` within `()` indicates that separate (hence `s`) / common (hence `c`) coefficients for the variables to the right of `|` within the same `()` are to be added to the random part of the model, and allowed to vary at level 2; applies to multivariate normal, multinomial and mixed responses models only.

- `{}` gives a vector of binary indicators specifying a common coefficient. 1 is to include the component at the corresponding positions; zero otherwise. These digits are separated by commas; applies to multivariate normal, multinomial and mixed responses models only.
- `.` Used for adding a separate coefficient for a particular component at a specific level; applies to multivariate normal, multinomial and mixed responses models only

If `Formula` is a formula object, θ_s/θ_c , $2s/2c$, and `{}` have to be replaced by `` θ_s `/` θ_c ``, `` $2s$ `/` $2c$ ``, and `()` respectively. Other syntax remains the same.

Value

Outputs an R list object, which is then used as the input for `write.IGLS` and/or `write.MCMC`.

Note

Note that some characters listed above have special meanings in the formula, so avoid using them when you name the random variable. Alphanumeric characters (i.e. `[:a-zA-Z0-9]`) are recommended for naming the random variable. They are also recommended for naming a reference category, inside `[]`. Note: use `[]` notation only in the fixed part when there is no categorical variable in the random effects. If there is one in the random part, the categorical variable has to be converted into a set of binary variables (e.g., using `Untoggle`).

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

`runMLwiN`, `write.IGLS`, `write.MCMC`, `Formula.translate`

fysio	<i>Data on physiotherapy referrals from 100 general practices in the Netherlands, collected in 1987</i>
-------	---

Description

These data were collected in 1987 as part of a large national survey of general practice (Van der Velden 1999).

Usage

`fysio`

Format

A data frame with 16700 observations on the following 14 variables:

gp_{id} GP identifier.

pat_{id} Patient identifier.

pat_{age} Patient age in years.

page_{grp} Patient age group, with ages grouped into 7 categories (ordered factor with levels page<35, 35<=page<45, 45<=page<55, 55<=page<65, 65<=page<75, 75<=page<85, 85<=page).

pat_{sex} Patient gender (factor with levels female, male).

pat_{insur} Patient insurance indicator (factor with levels privateins (privately insured), publicins (publically insured)).

pat_{edu} Patient education level (ordered factor with levels none (no formal education), primary (primary education), secondary (secondary and lower/middle vocational education), higher (higher vocational and university education)).

diag Primary diagnosis resulting from care episodes (factor with levels 1 (symptoms/complaints neck), 2 (symptoms/complaints back), 3 (myalgia/fibrositis), 4 (symptoms of multiple muscles), 5 (disabilities related to the locomotive system), 6 (impediments of the cervical spine), 7 (arthrosis cervical spine), 8 (lumbago), 9 (ischialgia), 10 (hernia nuclei pulposi), 11 (impediments of the shoulder), 12 (epicondylitis lateralis), 13 (tendinitis/synovitis)).

gp_{exper} GP experience (number of years working as a GP divided by ten).

gp_{workload} GP workload (number of contacts in the 3-month registration period divided by 1000).

pract_{type} Practice type (factor with levels solo, duo, group, healthcentre).

location Practice location (factor with levels rural, suburban, urban, bigcity).

gp_{physifr} Indicator of whether the GP has physiotherapists in their social network (factor with levels no, yes).

referral Indicator of whether the patient was referred to a physiotherapist (factor with levels no, yes).

Details

The *fysio* dataset is one of the example datasets analysed in Leyland and Groenewegen (2020), and provided with the multilevel-modelling software package MLwiN (Charlton et al., 2024).

Source

Charlton, C., Rasbash, J., Browne, W.J., Healy, M. and Cameron, B. (2024) *MLwiN Version 3.08* Centre for Multilevel Modelling, University of Bristol.

Leyland, A.H., Groenewegen, P.P. (2020). Multilevel Logistic Regression Using MLwiN: Referrals to Physiotherapy. In: *Multilevel Modelling for Public Health and Health Services Research*. Springer, Cham. doi:10.1007/9783030348014_12

Van der Velden, K. (1999). *General practice at work: its contribution to epidemiology and health policy*. NIVEL, PhD thesis Erasmus University, Utrecht

Examples

```

## Not run:

data(fysio, package = "R2MLwiN")

# Example taken from Leyland and Groenewegen (2020)

# Change contrasts if wish to avoid warning indicating that, by default,
# specified contrasts for ordered predictors will be ignored by runMLwiN
# (they will be fitted as "contr.treatment" regardless of this setting). To
# enable specified contrasts, set allowcontrast to TRUE (this will be the
# default in future package releases).
my_contrasts <- options("contrasts")$contrasts
options(contrasts = c(ordered = "contr.treatment",
                      ordered = "contr.treatment"))

# As an alternative to changing contrasts, can instead use C() to specify
# contrasts for ordered predictors in formula object, e.g.:

# F1 <- logit(referral) ~ 1 + C(pagegrp, "contr.treatment") + patsex + diag +
#   C(patedu, "contr.treatment") + patinsur + gpexper + gpworkload +
#   practype + location + gpphysifr +
#   (1 | gpid)
#
# (mod_MQL1 <- runMLwiN(Formula = F1,
#                       D = "Binomial",
#                       data = fysio,
#                       allowcontrast = TRUE))

F1 <- logit(referral) ~ 1 + pagegrp + patsex + diag +
  patedu + patinsur + gpexper + gpworkload +
  practype + location + gpphysifr +
  (1 | gpid)

(mod_MQL1 <- runMLwiN(Formula = F1,
                     D = "Binomial",
                     data = fysio))

(mod_PQL2 <- runMLwiN(Formula = F1,
                      estoptions = list(nonlinear = c(N = 1, M = 2),
                                         startval = list(FP.b = mod_MQL1@FP,
                                                           FP.v = mod_MQL1@FP.cov,
                                                           RP.b = mod_MQL1@RP,
                                                           RP.v = mod_MQL1@RP.cov)),
                      D = "Binomial",
                      data = fysio))

# Change contrasts back to pre-existing:
options(contrasts = my_contrasts)

## End(Not run)

```

gcsecomp1

*Pupils' marks from GCSE exams (UK, 1989); complete cases only.***Description**

Pupils' marks from GCSE exams, consisting of 1523 pupils across 73 schools. See Browne (2012) for further details.

Usage

gcsecomp1

Format

A data frame with 1523 observations on the following 6 variables:

school Identifying code for each school (level 2 unit).

student Identifying code for each pupil (level 1 unit).

female Gender of pupil: a factor with levels Male and Female.

written Exam score.

csework Coursework score.

cons Constant (=1).

Details

The gcsecomp1 dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009).

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:
```

```
data(gcsecomp1, package="R2MLwiN")
```

```
(mymodel <- runMLwiN(c(written, csework) ~ 1 + female + (1 | school) + (1 | student),
  D = "Multivariate Normal", estoptions = list(EstM = 1), data = gcsecomp1))
```

```
## End(Not run)
```

gcsemv1

Pupils' marks from GCSE exams (UK, 1989).

Description

GCSE exam results, taken from 73 schools in England, consisting of 1905 pupils.

Usage

gcsemv1

Format

A data frame with 1905 observations on the following variables:

school School identification (level 2 unit).

student Student identification (level 1 unit).

female Gender: a factor with levels Female and Male.

agemths Age in months.

written Score on the written component.

csework Score on the coursework component.

cons Constant (= 1).

Details

The gcsemv1 dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009); for further details see Rasbash et al. (2012).

Source

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) *A User's Guide to MLwiN Version 2.26*. Centre for Multilevel Modelling, University of Bristol.

See Also

See m1mRev package for an alternative format of the same dataset, with fewer variables.

Examples

```
## Not run:  
  
data(gcsemv1, package = "R2MLwiN")  
  
(mymodel <- runMLwiN(c(written, csework) ~ 1 + female + (1 | school) + (1 | student),  
  D = "Multivariate Normal", estoptions = list(EstM = 1), data = gcsemv1))  
  
## End(Not run)
```

getSummary.mlwinfitIGLS

*Extract coefficients and GOF measures from a statistical object
(memisc package).*

Description

Extract coefficients and GOF measures from a statistical object (memisc package).

Usage

```
## S3 method for class 'mlwinfitIGLS'  
getSummary(obj, alpha = 0.05, ...)
```

Arguments

obj	An mlwinfitIGLS-class model.
alpha	level of the confidence intervals; their coverage should be $1-\alpha/2$
...	Other arguments.

See Also

[getSummary](#)

`getSummary.mlwinfitMCMC`

Extract coefficients and GOF measures from a statistical object (memisc package).

Description

Extract coefficients and GOF measures from a statistical object (memisc package).

Usage

```
## S3 method for class 'mlwinfitMCMC'  
getSummary(obj, alpha = 0.05, ...)
```

Arguments

<code>obj</code>	An <code>mlwinfitMCMC</code> -class model.
<code>alpha</code>	level of the confidence intervals; their coverage should be $1-\alpha/2$
<code>...</code>	Other arguments.

See Also

[getSummary](#)

`glance.mlwinfitIGLS` *Extract GOF measures from a statistical object (broom package).*

Description

Extract GOF measures from a statistical object (broom package).

Usage

```
## S3 method for class 'mlwinfitIGLS'  
glance(x, ...)
```

Arguments

<code>x</code>	An <code>mlwinfitIGLS</code> -class model.
<code>...</code>	Other arguments.

See Also

[glance](#)

`glance.mlwinfitMCMC` *Extract GOF measures from a statistical object (broom package).*

Description

Extract GOF measures from a statistical object (broom package).

Usage

```
## S3 method for class 'mlwinfitMCMC'  
glance(x, ...)
```

Arguments

`x` An `mlwinfitMCMC`-class model.
`...` Other arguments.

See Also

[glance](#)

`height` *Height data.*

Description

Height data for 100 adult males.

Usage

```
height
```

Format

A data frame with 100 observations on the following variable:

height Heights of 100 adult males measured in centimetres.

Details

The height dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009); see Rasbash et al. (2012) for further details.

Source

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol. Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) *A User's Guide to MLwiN Version 2.26*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:
# from demo(UserGuide16)

data(height, package = "R2MLwiN")
summary(height)

hist(height$height)

1 - pnorm((200 - mean(height$height)) / sd(height$height))

heightsim1 <- function() {
  heightsim <- 175.35 + 10.002 * qnorm(runif(100))
  c(pmean = mean(heightsim), pvar = var(heightsim))
}

set.seed(1)

# Note: To obtain estimates as close as possible to the MLwiN manual,
# increase the number of reps to 10000.

simdata1 <- as.data.frame(t(replicate(1000, heightsim1())))
simdata1$iteration <- 1:nrow(simdata1)

plot(simdata1$iteration, simdata1$pmean, type = "l")

plot(density(simdata1$pmean))

quantile(simdata1$pmean, c(0.025, 0.975))

plot(simdata1$iteration, simdata1$pvar, type = "l")

plot(density(simdata1$pvar))

quantile(simdata1$pvar, c(0.025, 0.975))

heightsim2 <- function(variable) {
  samp <- sample(variable, replace = TRUE)
  c(npmean = mean(samp), npvar = var(samp))
}

simdata2 <- as.data.frame(t(replicate(1000, heightsim2(height$height))))
simdata2$iteration <- 1:nrow(simdata2)

plot(simdata2$iteration, simdata2$npmean, type = "l")
```

```

plot(density(simdata2$npmean))

quantile(simdata2$npmean, c(0.025, 0.975))

plot(simdata2$iteration, simdata2$npvar, type = "l")

plot(density(simdata2$npvar))

quantile(simdata2$npvar, c(0.025, 0.975))

## End(Not run)

```

hungary1	<i>Hungarian component of 2nd International Science Survey, '84; see Goldstein 2003</i>
----------	---

Description

Hungarian component of 2nd International Science Survey, consisting of 2439 women across 99 districts.

Usage

```
hungary1
```

Format

A data frame with 2439 observations on the following 10 variables:

school Identifying code for each school (level 2 unit).

female Gender indicator: a factor with levels Male and Female.

es_core Core Earth Sciences test result.

biol_core Core Biology test result.

biol_r3 Optional Biology test result.

biol_r4 Optional Biology test result.

phys_core Core Physics test result.

phys_r2 Optional Physics test result.

cons Constant(=1).

student Identifying code for each student (level 1 unit).

Details

The hungary1 dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009). Originally analysed in Goldstein (2003), further details can also be found in Browne (2012).

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Goldstein, H.. (2003) *Multilevel Statistical Models*. Third Edition. London, Edward Arnold.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:

data(hungary1, package = "R2MLwiN")

(mymodel <- runMLwiN(c(es_core, biol_core, biol_r3, biol_r4, phys_core, phys_r2) ~
  1 + female + (1 | school) + (1 | student),
  D = "Multivariate Normal", estoptions = list(EstM = 1), data = hungary1))

## End(Not run)
```

jspmix1

Dataset of pupils' test scores, a subset of the Junior School Project.

Description

An educational dataset of pupils' test scores, a subset of the Junior School Project (Mortimore et al., 1988).

Usage

```
jspmix1
```

Format

A data frame with 1119 observations on the following 8 variables:

school School identifying code.

id Pupil identifying code.

sex Sex of pupil; a factor with levels female and male.

fluent Fluency in English indicator, where 0 = beginner, 1 = intermediate, 2 = fully fluent; measured in Year 1.

ravens Test score, out of 40; measured in Year 1.

english Pupils' English test score, out of 100; measured in Year 3.

behaviour Pupils' behaviour score, where lowerquarter = pupil rated in bottom 25%, and upper otherwise; measured in Year 3.

cons A column of ones. If included as an explanatory variable in a regression model (e.g. in MLwiN), its coefficient is the intercept.

Details

A subset of the Junior School Project (Mortimore et al., 1988), the `jspmix1` dataset is one of the sample datasets provided with the multilevel-modelling software package `MLwiN` (Rasbash et al., 2009), and is used in Browne (2012) as an example of modelling mixed responses. It consists of test scores for 1119 pupils across 47 schools. Note that the behaviour variable originally had three categories, and the middle 50% and top 25% have been combined to produce a binary variable.)

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Mortimore, P., Sammons, P., Stoll, L., Lewis, D., Ecob, R. (1988) *School Matters*. Wells: Open Books.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:

data(jspmix1, package = "R2MLwiN")

jspmix1$denomb <- jspmix1$cons

(mymodel <- runMLwiN(c(english, probit(behaviour, denomb)) ~
  1 + sex + ravens + fluent[1] + (1 | school) + (1[1] | id),
  D = c("Mixed", "Normal", "Binomial"),
  estoptions = list(EstM = 1, mcmcMeth = list(fixM = 1, residM = 1, Lev1VarM = 1)),
  data = jspmix1))

## End(Not run)
```

lips1

Lips data

Description

Observed counts of male lip cancer for the 56 regions of Scotland over the period 1975-1980.

Usage

lips1

Format

A data frame with 56 observations on the following 41 variables:

area Region ID.

cons Constant (=1).

obs Observed cases of lip cancer.

exp Expected count.

perc_aff Percentage of the region who work in agriculture, fishing and forestry.

offs Log of the expected count.

pcons Constant (=1).

denom Constant (=1).

neigh1 First neighbours.

neigh2 Second neighbours.

neigh3 Third neighbours.

neigh4 Fourth neighbours.

neigh5 Fifth neighbours.

neigh6 Sixth neighbours.

neigh7 Seventh neighbours.

neigh8 Eighth neighbours.

neigh9 Ninth neighbours.

neigh10 Tenth neighbours.

neigh11 Eleventh neighbours.

weight1 First neighbours' weights.

weight2 Second neighbours' weights.

weight3 Third neighbours' weights.

weight4 Fourth neighbours' weights.

weight5 Fifth neighbours' weights.

weight6 Sixth neighbours' weights.

weight7 Seventh neighbours' weights.

weight8 Eighth neighbours' weights.

weight9 Ninth neighbours' weights.

weight10 Tenth neighbours' weights.

weight11 Eleventh neighbours' weights.

wcar1 First neighbours' CAR weights.

wcar2 Second neighbours' CAR weights.

wcar3 Third neighbours' CAR weights.

wcar4 Fourth neighbours' CAR weights.

wcar5 Fifth neighbours' CAR weights.

- wcar6** Sixth neighbours' CAR weights.
- wcar7** Seventh neighbours' CAR weights.
- wcar8** Eighth neighbours' CAR weights.
- wcar9** Ninth neighbours' CAR weights.
- wcar10** Tenth neighbours' CAR weights.
- wcar11** Eleventh neighbours' CAR weights.

Details

The `lips1` dataset is one of the sample datasets provided with the multilevel-modelling software package `MLwiN` (Rasbash et al., 2009), and was analysed in Clayton & Kaldor (1987); see also Browne (2012) for more details.

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Clayton, D., Kaldor, J. (1987) Empirical Bayes estimates of age-standardized relative risks for use in disease mapping. *Biometrics* 43: 671-681.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:

data(lips1, package = "R2MLwiN")

(mymodel <- runMLwiN(log(obs) ~ 1 + perc_aff + offset(off) + (0 | neigh1) + (1 | area),
  D = "Poisson", estoptions = list(EstM = 1), data = lips1))

## End(Not run)
```

lmdp

*Details of deaths from all causes in England and Wales 1972-1992,
taken from the local mortality datapack*

Description

This dataset records the annual number of deaths in a given district in England and Wales, covering 14 years (1972-1992) across 403 districts. Note that there are only 5639 observations rather than the 5642 that might be expected (403 districts with an observation for each of 14 years); 3 data points were removed because extreme outlying values made them implausible.

Usage

```
lmdp
```

Format

A data frame with 5639 observations on the following 8 variables:

county County (within region) identifier. There are 54 counties, coded from 1 to 68.

district District (within county) identifier. There are 403 districts, coded 101 to 6820.

region Region identifier. There are 10 regions, coded 1 to 10.

year Year, 1979 (79) to 1992 (92).

deaths Number of deaths observed

expected Expected number of deaths, based on the 1992 national age- and sex- specific mortality rates.

smr Standardised mortality ratio (observed deaths / expected deaths * 100).

family District classification into one of 6 groups as defined by the UK's Office for National Statistics (factor with levels Inner_London (Inner London), Rural (Rural areas), Prospering (Prospering areas) Maturer (Maturer areas), Urban (Urban areas), Mining_industrial (Mining and industrial areas)).

Details

The lmdp dataset is one of the example datasets analysed in Leyland and Groenewegen (2020), and provided with the multilevel-modelling software package MLwiN (Charlton et al., 2024).

Source

Charlton, C., Rasbash, J., Browne, W.J., Healy, M. and Cameron, B. (2024) *MLwiN Version 3.08* Centre for Multilevel Modelling, University of Bristol.

Leyland, A.H., Groenewegen, P.P. (2020). Multilevel Linear Regression Using MLwiN: Mortality in England and Wales, 1979-1992. In: *Multilevel Modelling for Public Health and Health Services Research*. Springer, Cham. doi:10.1007/9783030348014_11

Examples

```
## Not run:

data(lmdp, package = "R2MLwiN")

# Example taken from Leyland and Groenewegen (2020)

lmdp$ID <- seq(1:nrow(lmdp))

(mod_1 <- runMLwiN(smr ~ 1 + I(year - 79) +
                  (1 | district) + (1 | ID),
                  data = lmdp))

## End(Not run)
```

logLik,mlwinfitIGLS-method

Returns the log-likelihood from "mlwinfitIGLS" objects.

Description

Returns the log-likelihood from "mlwinfitIGLS" objects.

Usage

```
## S4 method for signature 'mlwinfitIGLS'  
logLik(object, ...)
```

Arguments

object	An mlwinfitIGLS-class object.
...	Other arguments.

See Also

[logLik-methods](#)

logLik.mlwinfitIGLS *Returns the log-likelihood from "mlwinfitIGLS" objects.*

Description

Returns the log-likelihood from "mlwinfitIGLS" objects.

Usage

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

Arguments

object	An mlwinfitIGLS-class object.
...	Other arguments.

See Also

[logLik](#)

matrix2df	<p><i>For multiple membership models, translates matrix into a data.frame formatted for MLwiN Translates a matrix into a form usable by MLwiN for multiple membership models, namely a data.frame with (a) columns containing membership IDs (if first row matrix is 0 1 1 0 1 1, then first row of generated ID vectors would be, say, 2, 3, 5, 6) and (b) columns containing weights (in this example, if standardise = TRUE, then first row of generated weight vectors would be, say, 0.25, 0.25, 0.25, 0.25, otherwise first row of generated weight vectors would be, say, 1, 1, 1, 1).</i></p>
-----------	---

Description

For multiple membership models, translates matrix into a data.frame formatted for MLwiN

Translates a [matrix](#) into a form usable by MLwiN for multiple membership models, namely a [data.frame](#) with (a) columns containing membership IDs (if first row matrix is 0 1 1 0 1 1, then first row of generated ID vectors would be, say, 2, 3, 5, 6) and (b) columns containing weights (in this example, if standardise = TRUE, then first row of generated weight vectors would be, say, 0.25, 0.25, 0.25, 0.25, otherwise first row of generated weight vectors would be, say, 1, 1, 1, 1).

Usage

```
matrix2df(mat, standardise = FALSE, idstub = "id", weightstub = "weight")
```

Arguments

mat	A matrix.
standardise	If TRUE, ensures the row sums to one; defaults to FALSE.
idstub	Prefix for columns containing IDs; defaults to id.
weightstub	Prefix for columns containing weights; defaults to weight.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol, U.K.

See Also

[df2matrix](#)

MCSE

Calculates the estimated Monte Carlo standard error (MCSE)

Description

An internal function which calculates the estimated Monte Carlo standard error (MCSE) for the posterior estimate of the mean, for use in [sixway](#). As MCMC is a simulation-based approach this induces (Monte Carlo) uncertainty due to the random numbers it uses. This uncertainty reduces with more iterations, and is measured by the MCSE. See Browne (2012) for further details.

Usage

```
MCSE(chain, rho, ll = 0.5, ul = 20)
```

Arguments

chain	Vector or mcmc object.
rho	ACF for first lag.
ll	Lower limit of x-axis, where value specified is multiplied by the length of the chain. Defaults to 0.5.
ul	Upper limit of x-axis, where value specified is multiplied by the length of the chain. Defaults to 20.

Value

The Monte Carlo standard error (MCSE) for the posterior estimate of the mean is returned.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

References

Browne, W.J. (2012) MCMC Estimation in MLwiN, v2.26. Centre for Multilevel Modelling, University of Bristol.

See Also

[sixway](#)

mlwin2bugs	<i>This function captures output files from MLwiN for estimation in WinBUGS/OpenBUGS.</i>
------------	---

Description

This function allows R to call WinBUGS using the output files from MLwiN. This function uses functionalities in the [R2WinBUGS-package](#) package.

Usage

```
mlwin2bugs(
  D,
  levID,
  datafile,
  initfiles,
  modelfile,
  bugEst,
  fact,
  addmore,
  n.chains,
  n.iter,
  n.burnin,
  n.thin,
  debug = FALSE,
  bugs.directory = bugs.directory,
  bugsWorkingDir = tempdir(),
  OpenBugs = FALSE,
  cleanBugsWorkingDir = FALSE,
  seed = NULL
)
```

Arguments

D	A vector specifying the type of distribution used in the model.
levID	A character (vector) specifying the level ID(s).
datafile	A file name where the BUGS data file will be saved in .txt format.
initfiles	A list of file names where the BUGS initial values will be saved in .txt format.
modelfile	A file name where the BUGS model will be saved in .txt format.
bugEst	A file name where the estimates from BUGS will be stored in .txt format.
fact	A list of objects used to specify factor analysis. See ‘Details’ below.
addmore	A vector of strings specifying additional coefficients to be monitored.
n.chains	The number of chains to be monitored.
n.iter	The number of iterations for each chain

n.burnin	The length of burn-in for each chain
n.thin	Thinning rate
debug	A logical value indicating whether (TRUE) or not (FALSE; the default) to close the BUGS window after completion of the model run
bugs.directory	The full path of location where WinBUGS is installed (ignored if OpenBugs is TRUE).
bugsWorkingDir	A directory where all the intermediate files are to be stored; defaults to tempdir().
OpenBugs	If TRUE, OpenBUGS is used, if FALSE (the default) WinBUGS is used.
cleanBugsWorkingDir	If TRUE, the generated files will be removed from the bugsWorkingDir; defaults to FALSE.
seed	An integer specifying the random seed.

Details

A list of objects to specify factor analysis, as used in the argument fact:

- nfact: specifies the number of factors;
- lev.fact: Specifies the level/classification for the random part of the factor for each factor;
- nfactcor: specifies the number of correlated factors;
- factcor: a vector specifying the correlated factors: the first element corresponds to the first factor number, the second to the second factor number, the third element corresponds to the starting value for the covariance and the fourth element to whether this covariance is constrained (1) or not (0). If more than one pair of factors is correlated, then repeat this sequence for each pair.
- loading: a matrix specifying the starting values for the factor loadings and the starting value of the factor variance. Each row corresponds to a factor.
- constr: a matrix specifying indicators of whether the factor loadings and the factor variance are constrained (1) or not (0).

Value

Returns an [mcmc](#) object.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[runMLwiN,bugs](#)

mlwinfitIGLS-class *An S4 class that stores the outputs of the fitted IGLS model.*

Description

An MLwiN model run via the IGLS estimation method is represented by an "mlwinfitIGLS" object

Slots

Nobs Computes the number of complete observations.

DataLength Total number of cases.

Hierarchy For each higher level of a multilevel model, returns the number of units at that level, together with the minimum, mean and maximum number of lower-level units nested within units of the current level.

D A vector specifying the type of distribution to be modelled, which can include 'Normal', 'Binomial', 'Poisson', 'Multinomial', 'Multivariate Normal', or 'Mixed'.

Formula A formula object (or a character string) specifying a multilevel model.

levID A character string (vector) of the specified level ID(s).

contrasts A list of contrast matrices, one for each factor in the model.

xlevels A list of levels for the factors in the model.

FP Displays the fixed part estimates.

RP Displays the random part estimates.

FP.cov Displays a covariance matrix of the fixed part estimates.

RP.cov Displays a covariance matrix of the random part estimates.

elapsed.time Calculates the CPU time used for fitting the model.

call The matched call.

LIKE The deviance statistic ($-2 \cdot \log(\text{like})$).

Converged Boolean indicating whether the model has converged

Iterations Number of iterations that the model has run for

Meth If Meth = 0 estimation method is set to RIGLS. If Meth = 1 estimation method is set to IGLS.

residual If resi.store is TRUE, then the residual estimates at all levels are returned.

data The data.frame that was used to fit the model.

nonlinear A character vector specifying linearisation method used. The first element specifies marginal quasi-likelihood linearization (N = 0) or penalised quasi-likelihood linearization (N = 1); The second element specifies first (M = 1) or second (M = 2) order approximation.

version The MLwiN version used to fit the model

An instance of the Class

An instance is created by calling function `runMLwiN`.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[runMLwiN](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

## Example: tutorial
data(tutorial, package = "R2MLwiN")

(mymodel <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | school) + (1 | student),
  data = tutorial))

##summary method
summary(mymodel)

##logLik method
logLik(mymodel)

## End(Not run)
```

mlwinfitMCMC-class *An S4 class that stores the outputs of the fitted MCMC model.*

Description

An MLwiN model run via the MCMC estimation method is represented by an "mlwinfitMCMC" object

Slots

Nobs Computes the number of complete observations.

DataLength Total number of cases.

Hierarchy For each higher level of a multilevel model, returns the number of units at that level, together with the minimum, mean and maximum number of lower-level units nested within units of the current level.

burnin An integer specifying length of the burn-in.

nchains An integer specifying number of MCMC chains run.
iterations An integer specifying the number of iterations after burn-in.
D A vector specifying the type of distribution to be modelled, which can include 'Normal', 'Binomial', 'Poisson', 'Multinomial', 'Multivariate Normal', or 'Mixed'.
Formula A formula object (or a character string) specifying a multilevel model.
levID A character string (vector) of the specified level ID(s).
contrasts A list of contrast matrices, one for each factor in the model.
xlevels A list of levels for the factors in the model.
merr A vector which sets-up measurement errors on predictor variables.
fact A list of objects specified for factor analysis, including *nfact*, *lev.fact*, *nfactor*, *factor*, *loading* and *constr*.
xc A list of objects specified for cross-classified and/or multiple membership models, including *class*, *N1*, *weight*, *id* and *car*.
FP Displays the fixed part estimates.
RP Displays the random part estimates.
FP.cov Displays a covariance matrix of the fixed part estimates.
RP.cov Displays a covariance matrix of the random part estimates.
chains Captures the MCMC chains from MLwiN for all parameters.
elapsed.time Calculates the CPU time used for fitting the model.
BDIC Bayesian Deviance Information Criterion (DIC)
call The matched call.
LIKE The deviance statistic ($-2 \cdot \log(\text{like})$).
fact.loadings If *fact* is not empty, then the factor loadings are returned.
fact.loadings.sd If *fact* is not empty, then the factor loading standard deviations are returned.
fact.cov If *fact* is not empty, then factor covariances are returned.
fact.cov.sd If *fact* is not empty, then factor covariance standard deviations are returned.
fact.chains If *fact* is not empty, then the factor chains are returned.
Mldata If *dami[1]* is one then the mean complete response variable *y* is returned for each chain, if *dami[1]* is two then the SD is also included.
imputations If *dami[1]* is zero, then a list of completed datasets containing complete response variable *y* is returned.
residual If *resi.store* is TRUE, then the residual estimates at all levels are returned.
resi.chains If *resi.store.levs* is not empty, then the residual chains at these levels are returned.
version The MLwiN version used to fit the model
data The data.frame that was used to fit the model.

An instance of the Class

An instance is created by calling function `runMLwiN`.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[runMLwiN](#)

Examples

```
## Not run:

library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

## Example: tutorial
data(tutorial, package = "R2MLwiN")

(mymodel <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | school) + (1 | student),
  estoptions = list(EstM = 1), data = tutorial))

##summary method
summary(mymodel)

##BDIC slot
mymodel@BDIC

## End(Not run)
```

mmmec

EC data on UV radiation exposure & malignant melanoma.

Description

EC data on UV radiation exposure & malignant melanoma, consisting of 354 counties across 79 regions across 9 nations.

Usage

mmmec

Format

A data frame with 354 observations on the following variables:

nation Nation ID: a factor with levels corresponding to each country.

region Region (within-nation) ID.

county County (within-region) ID.

obs Number of male deaths due to malignant melanoma between 1971 and 1980.

exp Expected number of deaths - proportional to county population.

cons Constant (=1).

uvbi County-level measurement of UV B radiation, centered on the mean.

Details

The mmec dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009). Further information can be found in Langford et al. (1998) and Browne (2012).

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Langford, I. H., Bentham, G., McDonald, A-L. (1998) Multi-level modelling of geographically aggregated health data: a case study on malignant melanoma mortality and UV exposure in the European Community. *Statistics in Medicine* 17: 41-57.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

See Also

See `mLmRev` package for an alternative format of the same dataset, with fewer variables.

Examples

```
## Not run:

data(mmec, package = "R2MLwiN")

(mymodel3 <- runMLwiN(log(obs) ~ 1 + uvbi + offset(log(exp)) + (1 | nation) + (1 | region),
  D = "Poisson", estoptions = list(EstM = 1), data = mmec))

## End(Not run)
```

nobs.mlwinfitIGLS	Returns the number of used observations from "mlwinfitIGLS" objects.
-------------------	--

Description

Returns the number of used observations from "mlwinfitIGLS" objects.

Usage

```
## S3 method for class 'mlwinfitIGLS'  
nobs(object, ...)
```

Arguments

object	An mlwinfitIGLS-class object.
...	Other arguments.

See Also

[nobs](#)

nobs.mlwinfitMCMC	Returns the number of used observations from "mlwinfitMCMC" objects.
-------------------	--

Description

Returns the number of used observations from "mlwinfitMCMC" objects.

Usage

```
## S3 method for class 'mlwinfitMCMC'  
nobs(object, ...)
```

Arguments

object	An mlwinfitMCMC-class object.
...	Other arguments.

See Also

[nobs](#)

predCurves	<i>Draws predicted curves (lines) using estimates from the fixed part of a fitted model.</i>
------------	--

Description

This function draws predicted curves (lines) against an explanatory variable for each category of a categorical variable.

Usage

```
predCurves(
  object,
  indata = NULL,
  xname,
  group = NULL,
  legend = TRUE,
  legend.space = "top",
  legend.ncol = 2,
  ...
)
```

Arguments

object	Either an mlwinfitIGLS-class or mlwinfitMCMC-class object.
indata	A data.frame object containing the data. If not specified, data is extracted from the object.
xname	The name of variable to be plotted.
group	A character string or a sequence of length equivalent to rows of data to plot. group = NULL by default.
legend	A logical value indicating whether a legend for group is to be added.
legend.space	A character string specifies one of the four sides, which can be one of 'top', 'bottom', 'left' and 'right'. Default, legend.space = 'top'.
legend.ncol	An integer specifies a number of columns, possibly divided into blocks, each containing some rows. Default, legend.ncol = 2.
...	Other arguments to be passed to xyplot .

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[predLines](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

## Read alevchem data
data(alevchem, package = "R2MLwiN")

alevchem$gcseav <- alevchem$gcse_tot/alevchem$gcse_no - 6
# Avoids warning when fitting factor as continuous response:
alevchem$a_point_num <- as.numeric(alevchem$a_point)

## Example: A-level Chemistry
(mymodel <- runMLwiN(a_point_num ~ 1 + gcseav + I(gcseav^2) + I(gcseav^3)
  + gender + (1 | pupil), estoptions = list(EstM = 1, resi.store = TRUE),
  data = alevchem))

predCurves(mymodel, xname = "gcseav", group = "genderfemale")

## End(Not run)
```

predict.mlwinfitIGLS *Returns the predicted data from "mlwinfitIGLS" objects.*

Description

Returns the predicted data from "mlwinfitIGLS" objects.

Usage

```
## S3 method for class 'mlwinfitIGLS'
predict(
  object,
  newdata = NULL,
  params = NULL,
  type = "link",
  se.fit = FALSE,
  terms = NULL,
  ...
)
```

Arguments

object An `mlwinfitIGLS`-class object.

newdata	data frame for which to evaluate predictions
params	a character vector specifying the parameters to use in evaluating predictions. If NULL, names(object[["FP"]]) is used by default.
type	when this has the value "link" (default) the linear predictor is returned. When type="terms" each component of the linear predictor is returned seperately. When type="response" predictions on the scale of the response are returned.
se.fit	logical. When this is TRUE (not default) standard error estimates are returned for each prediction.
terms	if type="terms", which terms (default is all terms), a character vector.
...	Other arguments.

See Also

[predict](#)

predict.mlwinfitMCMC *Returns the predicted data from "mlwinfitMCMC" objects.*

Description

Returns the predicted data from "mlwinfitMCMC" objects.

Usage

```
## S3 method for class 'mlwinfitMCMC'
predict(
  object,
  newdata = NULL,
  params = NULL,
  type = "link",
  se.fit = FALSE,
  terms = NULL,
  ...
)
```

Arguments

object	An mlwinfitMCMC-class object.
newdata	data frame for which to evaluate predictions
params	a character vector specifying the parameters to use in evaluating predictions. If NULL, names(object[["FP"]]) is used by default.
type	when this has the value "link" (default) the linear predictor is returned. When type="terms" each component of the linear predictor is returned seperately. When type="response" predictions on the scale of the response are returned.

se.fit	logical. When this is TRUE (not default) standard error estimates are returned for each prediction.
terms	if type="terms", which terms (default is all terms), a character vector.
...	Other arguments

See Also

[predict](#)

predLines *Draws predicted lines using a fitted model object*

Description

This function draws predicted lines against an explanatory variable for selected groups at a higher (≥ 2) level. Note that it uses a lot of contiguous memory, and so we recommend running via 64-bit version R to mitigate against any potential problems.

Usage

```
predLines(
  object,
  indata = NULL,
  xname,
  lev = 2,
  selected = NULL,
  probs = c(0.025, 0.975),
  legend = TRUE,
  legend.space = "top",
  legend.ncol = 4,
  ...
)
```

Arguments

object	Either an mlwinfitIGLS-class or mlwinfitMCMC-class object.
indata	A data.frame object containing the data. If not specified, data is extracted from the object.
xname	The name of the variable to be plotted.
lev	A digit indicating the level (of the multilevel model) at which to plot.
selected	A vector specifying groups to selectively plot at the level specified in lev. If selected = NULL, then all groups at that level are included.
probs	A numeric vector of probabilities with values in $[0, 1]$ used to calculate the lower and upper quantiles from which the error bars are plotted. Currently, this is only available for an mlwinfitMCMC-class object.

legend	A logical value indicating whether a legend is to be added.
legend.space	A character string specifies one of the four sides, which can be one of 'top', 'bottom', 'left' and 'right'. Default, legend.space = 'top'.
legend.ncol	An integer specifies a number of columns, possibly divided into blocks, each containing some rows. Default, legend.ncol = 2.
...	Other arguments to be passed to xyplot .

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[predCurves](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

## Example: tutorial
data(tutorial, package = "R2MLwiN")
(mymodel <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | school) + (1 | student),
  estoptions = list(EstM = 1, resi.store.levs = 2), data = tutorial))

predLines(mymodel, xname = "standlrt", lev = 2, selected = c(30, 44, 53, 59),
  probs = c(0.025, 0.975))

## End(Not run)
```

print.mlwinfitIGLS *Summarize "mlwinfitIGLS" objects*

Description

Summarize "mlwinfitIGLS" objects

Usage

```
## S3 method for class 'mlwinfitIGLS'
print(
  x,
  digits = max(3, getOption("digits") - 2),
  signif.stars = getOption("show.signif.stars"),
  ...
)
```

Arguments

x	an mlwinfitIGLS-class object
digits	the number of significant digits to use when printing.
signif.stars	logical. If TRUE, 'significance stars' are printed for each coefficient.
...	other parameters

See Also

[print](#)

print.mlwinfitMCMC *Summarize "mlwinfitMCMC" objects*

Description

Summarize "mlwinfitMCMC" objects

Usage

```
## S3 method for class 'mlwinfitMCMC'
print(
  x,
  digits = max(3, getOption("digits") - 2),
  signif.stars = getOption("show.signif.stars"),
  z.ratio = TRUE,
  ...
)
```

Arguments

x	an mlwinfitMCMC-class object
digits	the number of significant digits to use when printing.
signif.stars	logical. If TRUE, 'significance stars' are printed for each coefficient.
z.ratio	logical. If TRUE, z-ratio values are displayed for each coefficient.
...	other parameters

See Also[print](#)

prior2macro	<i>Translates informative prior information into a concise MLwiN macro.</i>
-------------	---

Description

An internal function which takes an R list object containing informative prior information for a multilevel model and translates it into a concise vector object to be used in an MLwiN macro.

Usage

```
prior2macro(prior, D, fpart, nrand)
```

Arguments

prior	An R list object containing prior information for a multilevel model. See ‘Details’ below.
D	A character string specifying the type of distribution, which can be one of 'Normal', 'Binomial', 'Poisson', 'Negbinom', 'Multinomial', 'Multivariate Normal', or 'Mixed'
fpart	An R list containing the list of fixed part parameter labels.
nrand	An R list of lists, containing the number of random parameters at each level.

Details

The prior list can contain the following:

- `fixe`: For the fixed parameters, if proper normal priors are used for some parameters, a list of vectors of length two is provided, each of which specifies the mean and the standard deviation. If not given, default ('flat' or 'diffuse') priors are used for the parameters. The names used in the list should match those in the model output.
- `rp<level number>`: A list object specifying the Wishart or gamma prior for the covariance matrix or scalar variance at the levels specified, e.g. `rp1` for level 1, `rp2` for level 2, etc. Consists of: (1) `estimate` – a prior guess for the true value of the covariance matrix; (2) `size` – sample size for guess. Note that this is a weakly-informative prior and the default prior is used if missing.

Value

A long vector is returned in the format of MLwiN macro language. This includes all the specified prior parameters.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[runMLwiN](#)

rats

Weights of 30 rats, measured weekly over 5 weeks.

Description

Weights of 30 rats, measured weekly over 5 weeks.

Usage

rats

Format

A data frame with 30 observations on the following 7 variables:

y8 Weight on day 8.

y15 Weight on day 15.

y22 Weight on day 22.

y29 Weight on day 29.

y36 Weight on day 36.

cons Constant(=1).

rat Rat ID

Details

The rats dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009); see Browne (2012) and Gelfand (1990) for further details.

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Gelfand, A. E., Hills, S.E., Racine-Poon, A., Smith, A.F.M. (1990) Illustration of Bayesian inference in normal data models using Gibbs sampling. *Journal of the American Statistical Association* 85: 972-985.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:

data(rats, package = "R2MLwiN")

(mymodel <- runMLwiN(c(y8, y15, y22, y29, y36) ~ 1 + (1 | rat),
  D = "Multivariate Normal", estoptions = list(EstM = 1),
  data = rats))

## End(Not run)
```

reading1

Students' reading attainment in inner London infant schools.

Description

Reading score data for 407 pupils across 6 occasions.

Usage

```
reading1
```

Format

A data frame with 407 observations on the following 13 variables:

id Unique pupil identifying code.

age1 Age at occasion 1.

read1 Reading score at occasion 1.

age2 Age at occasion 2.

read2 Reading score at occasion 2.

age3 Age at occasion 3.

read3 Reading score at occasion 3.

age4 Age at occasion 4.

read4 Reading score at occasion 4.

age5 Age at occasion 5.

read5 Reading score at occasion 5.

age6 Age at occasion 6.

read6 Reading score at occasion 6.

Details

The reading1 dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009), and was analysed in Tizard et al. (1988); see also Rasbash et al. (2012) for further details.

Source

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol. Rasbash, J., Steele, F., Browne, W.J., Goldstein, H. (2012) *A User's Guide to MLwiN v2.26*. University of Bristol: Centre for Multilevel Modelling. Tizard, B., Blatchford, P., Burke, J. & Farquhar, C. (1988). Young children at school in the inner city. Hove, Sussex: Lawrence Erlbaum.

Examples

```
## Not run:
# from demo(UserGuide13)

data(reading1, package = "R2MLwiN")
summary(reading1)

reading1[reading1 == -10] <- NA

summary(reading1)

reading <- reshape(reading1, idvar = "student", timevar = "id",
  varying = c("read1", "age1", "read2", "age2", "read3", "age3",
    "read4", "age4", "read5", "age5", "read6", "age6"),
  sep = "", direction = "long")

reading <- reading[c("student", "id", "age", "read")]
reading <- reading[order(reading$student, reading$id), ]

colnames(reading) <- c("student", "occasion", "age", "reading")
rownames(reading) <- NULL

summary(reading)

head(reading, 5)

tab <- aggregate(reading ~ occasion, reading,
  function(x) c(N = length(x), mean = mean(x), sd = sd(x)))
tab <- rbind(tab, c(NA, NA))
tab$reading[7, ] <- c(length(na.omit(reading$reading)),
  mean(na.omit(reading$reading)),
  sd(na.omit(reading$reading)))
rownames(tab)[7] <- "Total"
tab

tab <- aggregate(age ~ occasion, reading,
  function(x) c(N = length(x), mean = mean(x), sd = sd(x)))
```



```

tab <- rbind(tab, c(NA, NA))
tab$age[7, ] <- c(length(na.omit(reading$age)),
                 mean(na.omit(reading$age)),
                 sd(na.omit(reading$age)))
rownames(tab)[7] <- "Total"
tab

(mymodel1 <- runMLwiN(reading ~ 1 + (1 | student) + (1 | occasion),
                    data = reading))

## End(Not run)

```

residuals.mlwinfitIGLS

Returns the residual data from "mlwinfitIGLS" objects.

Description

Returns the residual data from "mlwinfitIGLS" objects.

Usage

```

## S3 method for class 'mlwinfitIGLS'
residuals(object, ...)

```

Arguments

object	An mlwinfitIGLS-class object
...	Other arguments.

See Also

[residuals](#)

residuals.mlwinfitMCMC

Returns the residual data from "mlwinfitMCMC" objects.

Description

Returns the residual data from "mlwinfitMCMC" objects.

Usage

```

## S3 method for class 'mlwinfitMCMC'
residuals(object, ...)

```

Arguments

object An `mlwinfitMCMC-class` object
 ... Other arguments.

See Also

[residuals](#)

runMLwiN

Calls MLwiN from R.

Description

This function executes MLwiN and then brings results back to R.

Usage

```
runMLwiN(
  Formula,
  levID = NULL,
  D = "Normal",
  data = NULL,
  estoptions = list(EstM = 0),
  BUGO = NULL,
  MLwiNPath = NULL,
  stdout = "",
  stderr = "",
  workdir = tempdir(),
  checkversion = TRUE,
  allowcontrast = FALSE,
  indata = NULL,
  saveworksheet = NULL
)
```

Arguments

Formula A [formula](#) object specifying the model formula. See [Formula.translate](#) ([Formula.translate.compat](#) details back-compatible functionality for deprecated syntax used in versions of **R2MLwiN** prior to 0.8-0) and also ‘Details’ below.

levID A character vector specifying the level ID(s). Deprecated syntax: by default this is NULL and level ID(s) are specified in the Formula object.

D A character string/vector specifying the type of distribution to be modelled, which can include ‘Normal’ (the default), ‘Binomial’, ‘Poisson’, ‘Negbinom’, ‘Unordered Multinomial’, ‘Ordered Multinomial’, ‘Multivariate Normal’, or ‘Mixed’. In the case of the latter, ‘Mixed’ precedes the response types

which also need to be listed in D, e.g. `c('Mixed', 'Normal', 'Binomial')`; these need to be listed in the same order to which they are referred to in the Formula object (see `Formula.translate`, `Formula.translate.compat`). For (R)IGLS estimation (i.e. `EstM = 0` in `estoptions`) 'Mixed' combinations can consist of 'Normal' and 'Binomial' or 'Normal' and 'Poisson'; for MCMC estimation (i.e. `EstM = 0`), on the other hand, only a combination of 'Normal' and 'Binomial' is available.

data	A <code>data.frame</code> object containing the data to be modelled. Optional (but recommended): if empty, data taken from environment of formula.
estoptions	A list of options used for estimating the model. See 'Details' below.
BUGO	A vector specifying BUGS options. If non-null, then WinBUGS/OpenBUGS, in conjunction with MLwiN, are used for modelling. Non-null only applicable if <code>EstM = 1</code> . See 'Details', below.
MLwiNPath	A path to the MLwiN folder. By default, <code>MLwiNPath = NULL</code> and path set by <code>options('MLwiN_path')</code> , the default for which can be changed via <code>options(MLwiN_path = 'path/to/MLwiN vX.XX/')</code> .
stdout	See <code>system2</code> ; '' by default (i.e. output to stdout sent to R console).
stderr	See <code>system2</code> ; '' by default (i.e. output to stderr sent to R console).
workdir	A path to the folder where the outputted files are to be saved. If the folder specified does not exist, a new folder of that name is created; <code>workdir = tempdir()</code> by default.
checkversion	If TRUE (default), returns version number unless (a) version detected is unknown or newer than MLwiN version available when current version of R2MLwiN was released, in which case returns text to this effect, or (b) version detected > 1 year older than MLwiN version available when current version of R2MLwiN was released, in which case function call stopped and user invited to update via usual channels. Can disable via FALSE e.g. if slowing execution time down (for example in a simulation).
allowcontrast	If TRUE, factor variables will follow the R behaviour when creating contrast variables. If FALSE (default) factor variables will be converted into a series of zero/one dummies.
indata	A <code>data.frame</code> object containing the data to be modelled. Deprecated syntax: by default this is NULL and the <code>data.frame</code> is instead referenced via <code>data</code> .
saveworksheet	A file name (or list of file names if more than one chain is specified) used to store the MLwiN worksheet after the model has been estimated.

Details

With regard to runMLwiN's Formula object, see [formula](#) for notes on general usage, noting the following differences:

- The intercept is not included by default (this is keeping with the manner in which models are specified in MLwiN). To include an intercept, then, one can specify e.g. `normexam ~ 1 + standlrt + (1 | student)` or, assuming `cons` is a constant of ones, `normexam ~ cons + standlrt + (cons | student)`. (Note also, as further detailed below, for normal response models the level 1 ID (student in this example) needs to be explicitly included in the random part of the model formula; this is not the case for discrete response models.

- The link function and denominator are included in the Formula object, e.g. fitting a logistic model in which the variable denom is specified as the denominator: $\text{logit}(\text{resp}, \text{denom}) \sim 1 + \text{age} + (1 | \text{region})$.

Further details are as follows.

The random part of the model is specified in sets of parentheses arranged in descending order with respect to their hierarchy. E.g. in the case of a 3-level model, the variable containing the level 3 ID is specified first, then the variable containing the level 2 ID, etc. Note that the variable containing the level 1 ID also needs to be explicitly specified unless it is a discrete response model (in which case you should not specify it).

The table below summarises the options for the Formula argument in **R2MLwiN**. They assume an intercept is added (via ~ 1 ; for alternative specifications see [formula](#)). `<link>` denotes the link function, `<y1>`, `<y2>`, etc. represent response variables, `<denom>` denotes the denominator, `<offs>` the offset (optional), `<L2>`, `<L1>`, etc. the variables containing the level 2 and level 1 identifying codes, and `<ref_cat>` represents the reference category of a categorical response variable (optional: if unspecified the lowest level of the factor is used as the reference category). Explanatory variables are specified as e.g. `<x1> + <x2>`. For 'Ordered Multinomial', 'Multivariate Normal' and 'Mixed' responses, [`<common>`] indicates a common coefficient (i.e. the same for each category) is to be fitted; here `<common>` takes the form of a numeric identifier indicating the responses for which a common coefficient is to be added (e.g. `[1:5]` to fit a common coefficient for categories 1 to 5 of a 6-point ordered variable, `[1]` to fit a common coefficient for the response variable specified first in the Formula object for a 'Mixed' response model, etc.) Otherwise a separate coefficient (i.e. one for each category) is added. For 'Mixed' response models, the Formula arguments need to be grouped in the order the distributions are listed in D.

* denotes IGLS only in the table below.

Distribution

Format of Formula object

'Normal'	<code><y1> ~ 1 + <x1> + (1 <L2>) + (1 <L1>) + ...</code>
'Poisson'	<code><link>(<y1>) ~ 1 + offset(<offs>) + <x1> + (1 <L2>) + ...</code>
'Negbinom'	<code><link>(<y1>) ~ 1 + offset(<offs>) + (1 <L2>) + ...</code>
'Binomial'	<code><link>(<y1>, <denom>) ~ 1 + <x1> + (1 <L2>) + ...</code>
'Unordered Multinomial'	<code><link>(<y1>, <denom>, <ref_cat>) ~ 1 + <x1> + (1 <L2>) + ...</code>
'Ordered Multinomial'	<code><link>(<y1>, <denom>, <ref_cat>) ~ 1 + <x1> + <x2>[<common>] + (1[<common>] <L3>) + (1 <L2>)</code>
'Multivariate Normal'	<code>c(<y1>, <y2>, ...) ~ 1 + <x1> + <x2>[<common>] + (1[<common>] <L3>) + (1 <L2>)</code>
<code>c('Mixed', 'Normal', 'Binomial')</code>	<code>c(<y1>, ..., <link> (<y2>, <denom>), ...) ~ 1 + <x1> + <x2>[<common>] + (1[<common>] <L3>) + (1 <L2>)</code>
<code>c('Mixed', 'Normal', 'Poisson')*</code>	<code>c(<y1>, ..., <link>(<y2>, <offset>), ...) ~ 1 + <x1> + <x2>[<common>] + (1[<common>] <L3>) + (1 <L2>)</code>

The argument `estoptions` is a list which can contain the following options used for estimating the model:

- `EstM`: specifies estimation method. When `EstM = 0` (default), estimation method is (R)IGLS, otherwise `EstM = 1` specifies MCMC estimation.
- `resi.store`: a logical value indicating whether residuals are to be stored or not. Defaults to FALSE.
- `resioptions`: a string vector to specify the various residual options. The 'variance' option calculates the posterior variances instead of the posterior standard errors; the 'standardised',

'leverage', 'influence' and 'deletion' options calculate standardised, leverage, influence and deletion residuals respectively; the 'sampling' option calculates the sampling variance covariance matrix for the residuals; the 'norecode' option prevents residuals with values exceedingly close or equal to zero from being recoded to missing. When EstM = 1 (i.e. MCMC estimation) 'variance' is default value, and the only other permissible value is 'standardised' (else function call stopped with appropriate error message). When EstM = 0 (i.e. (R)IGLS estimation), 'variance' cannot be specified together with 'standardised', 'leverage' or 'deletion' (function call stopped with appropriate error message). Default is `resioptions = c('variance')`.

- `resi.store.levs`: an integer vector indicating the levels at which the residual chains are to be stored (NULL by default). Non-NULL values not valid when EstM = 0 (i.e. (R)IGLS estimation), else if EstM = 0 and `resi.store.levs` non-NULL, residual chains at specified levels are returned.
- `debugmode`: a logical value determining whether MLwiN is run in the background or not. The default value is FALSE: i.e. MLwiN is run in the background. If TRUE the MLwiN GUI is opened, and then pauses after the model has been set-up, allowing user to check starting values; pressing 'Resume macro' will then fit the model. Once fit, pressing 'Resume macro' once more will save the outputs to the `workdir` ready to be read by **R2MLwiN**. Users can instead opt to 'Abort macro' in which case the outputs are not saved to the `workdir`. This option currently works for 32 bit version of MLwiN only (automatically switches unless `MLwiNPath` or `options(MLwiNPath)` has been set directly to the executable).
- `x64`: a logical value indicating whether the 64 bit version of MLwiN is used (unless `MLwiNPath` or `options(MLwiNPath)` has been set directly to the executable). The default is determined by the characteristics of the operating system on which the script is executed. If FALSE, the 32 bit version is called, if TRUE 64 bit version is called.
- `clean.files`: specifies whether the generated files are removed from the `workdir` (TRUE, the default) or not (FALSE).
- `show.file`: a logical value indicating whether the output files (e.g. MLwiN macro file) are shown on the screen. Defaults to FALSE.
- `clre`: a matrix used to define which elements of the random effects matrix to remove (i.e. hold constant at zero). Removes from the random part at level <first row> the covariance matrix element(s) defined by the pair(s) of rows <second row> <third row>. Each column corresponds to a removed entry of the covariance matrix. See e.g. `demo(UserGuide07)` for an example.
- `notation`: specifies the model subscript notation to be used in the MLwiN equations window. 'class' means no multiple subscripts, whereas 'level' has multiple subscripts. If `notation = NULL`, defaults to 'level' if '`xc = NULL`' else defaults to 'class'.
- `mem.init`: sets and displays worksheet capacities for the current MLwiN session. A vector of length 5 corresponding to the following order: number of levels (defaults to 1 + the number of levels specified in the function call); worksheet size in thousands of cells (default is 6000); the number of columns (default is 2500); the number of explanatory variables (default is 10 + number of explanatory variables calculated initially); the number of group labels (default is 20).
- `optimat`: instructs MLwiN to limit the maximum matrix size that can be allocated by the (R)IGLS algorithm. Specify `optimat = TRUE` if MLwiN gives the following error message 'Overflow allocating smatrix'. This error message arises if one or more higher-level units

is/are extremely large (containing more than 800 lower-level units). In this situation runMLwiN's default behaviour is to instruct MLwiN to allocate a larger matrix size to the (R)IGLS algorithm than is currently possible. Specifying `optimat = TRUE` caps the maximum matrix size at 800 lower-level units, circumventing the MLwiN error message, and allowing most MLwiN functionality.

- `nonlinear`: a character vector specifying linearisation method for discrete response models estimated via IGLS (see Chapter 9 of Rasbash et al 2012, and Goldstein 2011). `N = 0` specifies marginal quasi-likelihood linearization (MQL), whilst `N = 1` specifies penalised quasi-likelihood linearization (PQL); `M = 1` specifies first order approximation, whilst `M = 2` specifies second order approximation. `nonlinear = c(N = 0, M = 1)` by default. First order marginal quasi-likelihood (MQL1) only option for single-level discrete response models. Pertains to discrete response models estimated via IGLS: i.e. when `EstM = 0` in `estoptions`, and for starting values when estimated via IGLS for MCMC (`EstM = 1`).
- `Meth`: specifies which maximum likelihood estimation method is to be used. If `Meth = 0` estimation method is set to RIGLS. If `Meth = 1` estimation method is set to IGLS (the default setting). Pertains to models estimated via (R)IGLS: i.e. when `EstM = 0` in `estoptions`, and for starting values when estimated via (R)IGLS for MCMC (`EstM = 1`).
- `merr`: a vector which sets-up measurement errors on predictor variables. The first element `N` defines the number of variables that have measurement errors. Then, for each variable with measurement error, a pair of inputs are required: the first of these is the explanatory variable name as a character string, and the second is the variance of the measurement error for this variable. See `demo(MCMCGuide14)` for an example.
- `fact`: a list of objects specified for factor analysis, including:
 - `nfact`: Specifies the number of factors
 - `lev.fact`: Specifies the level/classification for the random part of the factor for each factor.
 - `nfactcor`: Specifies the number of correlated factors
 - `factcor`: A vector specifying the correlated factors: the first element corresponds to the first factor number, the second to the second factor number, the third element corresponds to the starting value for the covariance and the fourth element to whether this covariance is constrained (1) or not (0). If more than one pair of factors is correlated, then repeat this sequence for each pair.
 - `loading`: A matrix specifying the starting values for the factor loadings and the starting value of the factor variance. Each row corresponds to a factor.
 - `constr`: A matrix specifying indicators of whether the factor loadings and the factor variance are constrained (1) or not (0).
- `weighting`: a deprecated option for specifying weights in IGLS estimation: see `fpsandwich` and `rpsandwich` for new method of doing so. `weighting` is a list of objects including `levels`, `weights`, `mode`, `FSDE` and `RSDE`; see `write.IGLS` for details.
- `centring`: deprecated method (only applicable when using old syntax pre-R2MLwiN v.0.8-0) specifying function by which explanatory variables are to be centred (users can instead transform variables prior to runMLwiN call). If non-NULL, `centring` is used for the selected explanatory variables (`centring = NULL` by default). `centring` is a list of objects specifying the methods to be used to centre specific explanatory variables. E.g. `list(age = 1, ...)` specifies that the explanatory variable `age` is to be centred around its grand mean; `list(age = c(2, 'district'), ...)` specifies that `age` is to be centred around its group mean, where

group defined by the variable `district`; and `list(age = c(3, 18), ...)` specifies that age is to be centred around the value 18.

- `xclass`: a deprecated option for specifying cross-classified and/or multiple membership models; see `xc` and `mm` for new method of doing so. `xclass` is a list of objects including `class`, `N1`, `weight`, `id` and `car`; see [write.MCMC](#) for details.
- `mcmcOptions`: a list of objects specifying MCMC options, including the following:
 - `orth`: If `orth = 1`, orthogonal fixed effect vectors are used; zero otherwise.
 - `hcen`: An integer specifying the level where we use hierarchical centering.
 - `smcm`: If `smcm = 1`, structured MCMC is used; zero otherwise.
 - `smvn`: If `smvn = 1`, the structured MVN framework is used; zero otherwise.
 - `paex`: A matrix of $N \times 2$; in each row, if the second digit is 1, parameter expansion is used at level <the first digit>.
 - `mcco`: This command allows the user to have constrained settings for the lowest level variance matrix in a multivariate Normal model. If value is 0, it estimates distinct variances for each residual error and distinct covariances for each residual error pair. Four other settings are currently available:

- 1 fits structured errors with a common correlation parameter and a common variance parameter;
- 2 fits AR1 errors with a common variance parameter;
- 3 fits structured errors with a common correlation parameter and independent variance parameters;
- 4 fits AR1 errors with independent variance parameters.

- `drop.data`: If TRUE (default) only the data involved in the model is passed to MLwiN, otherwise the entire dataset in `data` is passed.
- `drop.levels`: If TRUE (default) any unused levels are dropped from factors, otherwise the dataset is left unchanged.
- `fpsandwich`: specifies standard error type for fixed parameters. If `fpsandwich = TRUE`, robust or ‘sandwich’ standard errors based on raw residuals are used, if `fpsandwich = FALSE` (default) then standard, uncorrected, IGLS or RIGLS computation used.
- `rpsandwich`: specifies standard error type for random parameters. If `rpsandwich = TRUE`, robust or ‘sandwich’ standard errors based on raw residuals are used, if `rpsandwich = FALSE` (default) then standard, uncorrected, IGLS or RIGLS ‘plug in’ estimates used.
- `smat`: a matrix with two rows the levels at which a diagonal matrix is to be specified. The first row specifies the level. If the value of the second row is 1 then the random covariance matrix is set to be diagonal.
- `maxiter`: a numeric value specifying the maximum number of iterations, from the start, before (R)IGLS estimation halts. Pertains to models estimated via (R)IGLS: i.e. when `EstM = 0` in `estoptions`, and for starting values when estimated via (R)IGLS for MCMC (`EstM = 1`).
- `tol`: a numeric value specifying the convergence criterion. If value is `m`, estimation will be deemed to have converged when the relative change in the estimate for all parameters from one iteration to the next is less than $10(-m)$. Defaults to value of 2 for `m` if not otherwise specified. Pertains to models estimated via (R)IGLS: i.e. when `EstM = 0` in `estoptions`, and for starting values when estimated via (R)IGLS for MCMC (`EstM = 1`).

- `extra`: if TRUE, extra binomial, extra negative binomial, extra Poisson or extra multinomial distributions assumed, else FALSE. can only be specified for discrete response models (i.e. 'Binomial', 'Negbinom', 'Poisson', 'Multinomial') estimated via (R)IGLS (i.e. `EstM = 0`).
- `reset`: a vector specifying the action to be taken, at each level, if a variance parameter is estimated at a particular iteration to be negative during estimation. Values specified in ascending order of level hierarchy: if 0 a negative variance estimate is reset to zero and so are any associated covariances; if 1 a negative variance estimate is reset to zero but not the associated covariances; if 2 no resetting takes place. E.g. `reset = c(0, 1)` to assign value 0 to level 1 and value 1 to level 2 of two-level model.
- `constraints`: `fixed.ui` and `fixed.ci` are used to specify constraints on the fixed coefficients, and `random.ui` and `random.ci` to specify constraints on the random parameters. The syntax for specifying just fixed parameter constraints is `constraints = list(fixed.ui = <fixed matrix>, fixed.ci = <fixed values>)`, where `<fixed matrix>` is a matrix where each row represents one fixed part parameter, in the same order that they appear in the results table, each column represents one constraint, and the values in the matrix are multipliers for the parameters; and `<fixed values>` is a vector of values, one per constraint, to which the parameters multiplied by the multipliers in the corresponding column of `<fixed matrix>` should be equal. For example, if we have a model with formula `y ~ 1 + x1 + x2 + x3 + x4 + (1|lev1ID)`, then `constraints = list(fixed.ui = matrix(c(0, 1, -1, 0, 0, 0, 0, 0, 1, 2), nrow = 5), fixed.ci = c(0, 2))` specifies the constraints that the coefficient of `x1` equals the coefficient of `x2` and that the coefficient of `x3` plus twice the coefficient of `x4` equals 2. Random constraints are specified similarly, and fixed and random constraints may be applied simultaneously. Applies to `EstM = 0` (i.e. estimation via (R)IGLS) only.
- `xc`: indicates whether model is cross-classified (TRUE) or nested (FALSE). Ignored if `EstM = 0`, i.e. only applicable to models estimated via MCMC. Defaults to `xc = FALSE`, unless either `mm` or `car` are non-NULL, in which case `xc = TRUE`. Supersedes deprecated `xclass`.
- `mm`: specifies the structure of a multiple membership model. Can be a list of variable names, a list of vectors, or a matrix (e.g. see `df2matrix`). In the case of the former, each element of the list corresponds to a level (classification) of the model, in descending order. If a level is not a multiple membership classification, then NA is specified. Otherwise, lists need to be assigned to `mmvar` and `weights`, with the former containing columns specifying the classification units, and the latter containing columns specifying the weights. Ignored if `EstM = 0`, i.e. only applicable to models estimated via MCMC. `mm = NULL` by default. Supersedes deprecated `xclass`. E.g. (from `demo(MCMCGuide16)`) for `logearn ~ 1 + age_40 + sex + parttime + (1 | company) + (1 | id)`, if `company` is a multiple membership classification with the variables indicating the classifications in `company`, `company2`, `company3`, `company4` and their weights in `weight1`, `weight2`, `weight3` and `weight4` then `mm = list(list(mmvar = list('company', 'company2', 'company3', 'company4'), weights = list('weight1', 'weight2', 'weight3', 'weight4')), NA)` with the NA, listed last, corresponding to the level 1 identifier (`id`).
- `car`: specifies the structure of a conditional autoregressive (CAR) model. Can be a list of variable names, a list of vectors, or a matrix (e.g. see `df2matrix`). In the case of the former, each element of the list corresponds to a level (classification) of the model, in descending order. If a level is not a spatial classification, then NA is specified. Otherwise, lists need to be assigned to `carvar` and `weights`, with the former containing columns specifying the spatial classification units, and the latter containing columns specifying the weights. See `demo(MCMCGuide17)` for examples. Ignored if `EstM = 0`, i.e. only applicable to models estimated via MCMC. `car = NULL` by default. Supersedes deprecated `xclass`. See `demo(MCMCGuide17)` for examples.

- `carcentre`: if CAR model (i.e. if `car` is non-NULL), `carcentre = TRUE` mean-centres all random effects at that level.
- `startval`: a list of numeric vectors specifying the starting values. If multiple chains requested (via `nchains`), then can be a list of such lists. `FP.b` corresponds to the estimates for the fixed part; `FP.v` specifies the variance/covariance estimates for the fixed part; `RP.b` specifies the variance estimates for the random part; `RP.v` corresponds to the variance/covariance matrix of the variance estimates for the random part. `startval = NULL` by default: i.e. when `EstM = 0` the OLS estimates are used, else if `EstM = 1` the estimates obtained from IGLS are used as the starting values for MCMC.
- `sort.force`: If `TRUE` will sort data based on hierarchy as determined by model formula; defaults to `FALSE`.
- `sort.ignore`: If `FALSE` will check data is sorted in a manner in keeping with the hierarchy implied by the model formula, and will return a warning if that is not the case.
- `rng.version`: An integer value specifying the random number generator version to be used by MLwiN. If 10 (the default) this will be the Mersenne Twister; If 0 this will be the 3-Seed Wichmann-Hill (default in MLwiN prior to version 3).
- `mcmcMeth`: list of objects specifying MCMC methodology and prior options, including the following (see [write.MCMC](#) for further details):
 - `iterations`: Number of main iterations post-burnin (i.e. monitoring chain length), defaults to 5000.
 - `burnin`: Length of burnin, defaults to 500.
 - `nchains`: Number of MCMC chains to run, defaults to 1.
 - `thinning`: Thinning factor, defaults to 1.
 - `seed`: MCMC random number seed, defaults to 1 when `nchains = 1`, and to `1:nchains` when multiple chains requested.
 - `priorParam`: A list specifying informative priors. This includes: `fixe` – for the fixed parameters, if proper normal priors are used for some parameters, a list of vectors of length two is provided, each of which specifies the mean and the standard deviation. If not given, default ('flat' or 'diffuse') priors are used for the parameters; `fixe.common` – for multivariate normal, multinomial and mixed response models, if common coefficients are added, use `fixe.common` rather than `fixe`; `fixe.sep` – if the common coefficients are added, use `fixe.sep` for the separate coefficients; `rp1` – a list object specifying the Wishart or gamma prior for the covariance matrix or scalar variance at level 1 (this consists of: (1) `estimate` – a prior guess for the true value of the covariance matrix; (2) `size` – sample size for guess. Note that this is a weakly-informative prior and the default prior is used if missing); `rp2` – a list object specifying the Wishart or gamma prior for the covariance matrix or scalar variance at level 2 (this consists of: (1) `estimate` – an estimate for the true value of the inverse of the covariance matrix; (2) `size` – the number of rows in the covariance matrix. Note that this is a weakly-informative prior and the default prior is used if missing).
 - `scale`: Scale factor for proposal variances: this number will be multiplied by the estimated parameter variance (from IGLS/RIGLS) to give the proposal distribution variance. Defaults to 5.8.
 - `refresh`: Number of iterations after which screen (in MLwiN GUI) is to be refreshed. Defaults to 50.

- `fixM`: Specifies the estimation method for the fixed effects: 1 for Gibbs sampling, 2 for univariate Metropolis-Hastings (MH) sampling and 3 for multivariate MH sampling. Defaults to 2 if Poisson, Multinomial, Binomial or Mixed model, else defaults to 1.
- `residM`: Specifies the estimation method for the random effects (residuals): 1 for Gibbs sampling, 2 for univariate Metropolis-Hastings (MH) sampling and 3 for multivariate MH sampling. Defaults to 2 if Poisson, Multinomial, Binomial or Mixed model, else defaults to 1.
- `Lev1VarM`: Specifies the estimation method for the level 1 variance: 1 for Gibbs sampling, 2 for univariate Metropolis-Hastings (MH) sampling and 3 for multivariate MH sampling. Defaults to 2 if Poisson, Multinomial, Binomial or Mixed model, else defaults to 1.
- `OtherVarM`: Specifies the estimation method for the higher level variance matrices: 1 for Gibbs sampling, 2 for univariate Metropolis-Hastings (MH) sampling and 3 for multivariate MH sampling. Defaults to 1.
- `adaption`: `adaption = 1` (the default) indicates adaptation is to be used, `adaption = 0` indicates it is not.
- `tol`: An integer specifying tolerance (as a percentage; defaults to 10) when `adaption = 1` (ignored if `adaption = 0`).
- `rate`: An integer specifying the acceptance rate (as a percentage; defaults to 50) when `adaption = 1` (ignored if `adaption = 0`).
- `priorcode`: A vector indicating which default priors are to be used for the variance parameters. It defaults to `c(gamma = 1)` in which case Gamma priors are used with MLwiN's defaults of Gamma a value (shape) = 0.001 and Gamma b value (scale) = 0.001, although alternative values for shape and scale can be specified in subsequent elements of the vector, e.g. `c(gamma = 1, shape = 0.5, scale = 0.2)`). Alternatively `c(uniform = 1)` specifies Uniform priors on the variance scale. To allow for back-compatibility with deprecated syntax used in versions of **R2MLwiN** prior to 0.8-2, if `priorcode` is instead specified as an integer, then 1 indicates that Gamma priors are used, whereas 0 indicates that Uniform priors are used. See the section on 'Priors' in the MLwiN help system for more details on the meaning of these priors.
- `startval`: Deprecated: starting values are now specified directly within `estoptions`.
- `lcl0`: Toggles on/off the possible forms of complex level 1 variation when using MCMC. By default (`lcl0 = 0`) the level 1 variation is expressed as a function of the predictors. Else (`lcl0 = 1`) the log of the level 1 precision (1/variance) is expressed as a function of the predictors. Defaults to `lcl0 = 0`.
- `dami`: Outputs a complete (i.e. including non-missing responses) response variable `y`. If `dami = c(0, <iter1>, <iter2>, ...)` then the response variables returned will be the value of `y` at the iterations quoted (as integers `<iter1>`, `<iter2>`, etc.); these can be used for multiple imputation. If `dami = 1` the value of `y` will be the mean estimate from the iterations produced. `dami = 2` is as for `dami = 1` but with the standard errors of the estimate additionally being stored. `dami = NULL` by default.

The argument `BUG0` is a vector specifying BUGS options as follows:

- `n.chains`: specifies the number of chains used by BUGS.
- `debug`: determines whether BUGS stays open following completion of the model run; `debug = FALSE` by default.
- `seed`: sets the random number generator in BUGS.

- `bugs.directory`: specifies the path where WinBUGS has been installed (not required if `OpenBugs = TRUE`).
- `OpenBugs`: if `OpenBugs = TRUE`, OpenBUGS is used. Otherwise (i.e. `OpenBugs = FALSE`, the default) WinBUGS is used.

Value

If BUGO is non-NULL then the output is an `mcmc.list` object.

If the IGLS algorithm is used (i.e., `EstM = 0`), then returns `mlwinfitIGLS-class` object; if MCMC estimation used (i.e., `EstM = 1`), then returns `mlwinfitMCMC-class` object.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

References

Goldstein, H. (2011) Multilevel Statistical Models. 4th Edition. London: John Wiley and Sons.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) A User's Guide to MLwiN Version 2.26. Centre for Multilevel Modelling, University of Bristol.

See Also

`formula`, `Formula.translate`, `Formula.translate.compat`, `write.IGLS`, `write.MCMC`

Examples

```
## The R2MLwiN package includes scripts to replicate all the analyses in
## Rasbash et al (2012) A User's Guide to MLwiN Version 2.26 and
## Browne, W.J. (2012) MCMC estimation in MLwiN Version 2.26.
## The MLwiN manuals are available online, see:
## http://www.bristol.ac.uk/cmm/software/mlwin/download/manuals.html

## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

## For a list of demo titles
demo(package = 'R2MLwiN')

## Take MCMCGuide03 as an example
## To view file
file.show(system.file('demo', 'MCMCGuide03.R', package='R2MLwiN'))

## To run the demo
demo(MCMCGuide03)
```

```
## End(Not run)
```

```
show,mlwinfitIGLS-method
```

```
Show objects of class "mlwinfitIGLS"
```

Description

Show objects of class "mlwinfitIGLS"

Usage

```
## S4 method for signature 'mlwinfitIGLS'  
show(object)
```

Arguments

object an [mlwinfitIGLS-class](#) object

See Also

[show-methods](#)

```
show,mlwinfitMCMC-method
```

```
Show objects of class "mlwinfitMCMC"
```

Description

Show objects of class "mlwinfitMCMC"

Usage

```
## S4 method for signature 'mlwinfitMCMC'  
show(object)
```

Arguments

object an [mlwinfitIGLS-class](#) object

See Also

[show-methods](#)

show.mlwinfitIGLS *Summarize "mlwinfitIGLS" objects*

Description

Summarize "mlwinfitIGLS" objects

Usage

```
## S3 method for class 'mlwinfitIGLS'  
show(object, ...)
```

Arguments

object an [mlwinfitIGLS-class](#) object
... other parameters

See Also

[show](#)

show.mlwinfitMCMC *Summarize "mlwinfitMCMC" objects*

Description

Summarize "mlwinfitMCMC" objects

Usage

```
## S3 method for class 'mlwinfitMCMC'  
show(object, ...)
```

Arguments

object an [mlwinfitMCMC-class](#) object
... other parameters

See Also

[show](#)

sixway	<i>Draws a sixway plot of MCMC diagnostics.</i>
--------	---

Description

This function produces a variety of diagnostic plots and statistics for MCMC chains.

Usage

```
sixway(chain, name = NULL, acf.maxlag = 100, pacf.maxlag = 10, ...)
```

Arguments

chain	A numeric vector, <code>mcmc</code> object or <code>mcmc.list</code> object (in which case uses its <code>thin</code> argument, otherwise assumes <code>thinning = 1</code>), storing the MCMC chain for a chosen parameter.
name	The parameter name. If <code>name = NULL</code> , the column name of <code>chain</code> will be used, unless that is also <code>NULL</code> in which case <code>'x'</code> is used.
acf.maxlag	Maximum lag at which to calculate the auto-correlation function. <code>acf.maxlag = 100</code> by default. See acf .
pacf.maxlag	Maximum lag at which to calculate the partial auto-correlation function. <code>pacf.maxlag = 10</code> by default. See pacf .
...	Other graphical parameters (see par for details).

Details

A variety of plots and statistics are displayed in an R graphic window, including the following:

- a trace plot of the plotted trajectory of an MCMC chain for a model parameter;
- a kernel density plot; kernel density estimates are computed using [density](#);
- a plotted autocorrelation function (uses [acf](#));
- a plotted partial autocorrelation function (uses [pacf](#));
- a plot of the estimated Monte Carlo standard error (MCSE) of the posterior estimate of the mean against the number of iterations. As MCMC is a simulation-based approach this induces (Monte Carlo) uncertainty due to the random numbers it uses. This uncertainty reduces with more iterations, and is measured by the MCSE, and so this graph details how long the chain needs to be run to achieve a specific MCSE;
- a box contains two contrasting accuracy diagnostics. The Raftery-Lewis diagnostic ([raftery.diag](#)) is a diagnostic based on a particular quantile of the distribution. The diagnostic N_{hat} is used to estimate the length of Markov chain required to estimate a particular quantile (e.g. the 2.5% and 97.5% quantiles) to a given accuracy. The Brooks-Draper diagnostic (BD) is a diagnostic based on the mean of the distribution. It is used to estimate the length of Markov chain required to produce a mean estimate to $k(=2)$ significant figures with a given accuracy;
- a box of summary statistics including the posterior mean, sd, mode, quantiles and the effective sample size (ESS) of the chain.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[BD](#),[MCSE](#),[density](#),[acf](#),[pacf](#),[raftery.diag](#),[effectiveSize](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

## Example: tutorial
data(tutorial, package = "R2MLwiN")

(mymodel <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | school) + (1 | student),
  estoptions = list(EstM = 1, resi.store.levs = 2), data = tutorial))

sixway(mymodel@chains[, "FP_standlrt", drop = FALSE], "beta_1")

## End(Not run)
```

```
summary,mlwinfitIGLS-method
```

```
Summarize "mlwinfitIGLS" objects
```

Description

Summarize "mlwinfitIGLS" objects

Usage

```
## S4 method for signature 'mlwinfitIGLS'
summary(object, ...)
```

Arguments

object	an mlwinfitIGLS-class object
...	other parameters

See Also[summary-methods](#)

summary,mlwinfitMCMC-method
Summarize "mlwinfitMCMC" objects

Description

Summarize "mlwinfitMCMC" objects

Usage

```
## S4 method for signature 'mlwinfitMCMC'
summary(object, ...)
```

Arguments

object	an mlwinfitMCMC-class object
...	other parameters

See Also[summary-methods](#)

summary.mlwinfitIGLS *Summarize "mlwinfitIGLS" objects*

Description

Summarize "mlwinfitIGLS" objects

Usage

```
## S3 method for class 'mlwinfitIGLS'
summary(object, ...)
```

Arguments

object	an mlwinfitIGLS-class object
...	other parameters

summary.mlwinfitMCMC *Summarize "mlwinfitMCMC" objects*

Description

Summarize "mlwinfitMCMC" objects

Usage

```
## S3 method for class 'mlwinfitMCMC'
summary(object, ...)
```

Arguments

object	an <code>mlwinfitMCMC</code> -class object
...	other parameters

tidy.mlwinfitIGLS *Summarises information about the components of a model from a statistical object (broom package).*

Description

Summarises information about the components of a model from a statistical object (broom package).

Usage

```
## S3 method for class 'mlwinfitIGLS'
tidy(x, conf.int = FALSE, conf.level = 0.95, ...)
```

Arguments

x	An <code>mlwinfitIGLS</code> -class model.
conf.int	should the confidence interval be included?
conf.level	confidence interval level
...	Other arguments.

See Also

[tidy](#)

<code>tidy.mlwinfitMCMC</code>	<i>Summarises information about the components of a model from a statistical object (broom package).</i>
--------------------------------	--

Description

Summarises information about the components of a model from a statistical object (broom package).

Usage

```
## S3 method for class 'mlwinfitMCMC'
tidy(x, conf.int = FALSE, conf.level = 0.95, ...)
```

Arguments

<code>x</code>	An <code>mlwinfitMCMC</code> -class model.
<code>conf.int</code>	should the confidence interval be included?
<code>conf.level</code>	confidence interval level
<code>...</code>	Other arguments.

See Also

[tidy](#)

<code>trajectories</code>	<i>Plots MCMC chain trajectories</i>
---------------------------	--------------------------------------

Description

This function draws trajectories of MCMC chains.

Usage

```
trajectories(object, Range = c(1, 5000), selected = NULL)
```

Arguments

<code>object</code>	An <code>mlwinfitMCMC</code> -class, <code>mcmc</code> or <code>mcmc.list</code> object, or other object that can be converted to an <code>mcmc</code> object.
<code>Range</code>	An integer vector of length two specifying the first and last iterations of the chains.
<code>selected</code>	A character vector specifying the selected chains to be plotted.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[sixway](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')

## Example: tutorial
data(tutorial, package = "R2MLwiN")

(mymodel <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | student),
  estoptions = list(EstM = 1), data = tutorial))

trajectories(mymodel, Range = c(4501, 5000))

## End(Not run)
```

tutorial

Exam results for six inner London Education Authorities

Description

A subset of data from a much larger dataset of examination results from six inner London Education Authorities (school boards).

Usage

tutorial

Format

A data frame with 4059 observations on the following 10 variables:

school Numeric school identifier.

student Numeric student identifier.

normexam Students' exam score at age 16, normalised to have approximately a standard Normal distribution.

cons A column of ones. If included as an explanatory variable in a regression model (e.g. in MLwiN), its coefficient is the intercept.

standlrt Students' score at age 11 on the London Reading Test (LRT), standardised using Z-scores.

sex Sex of pupil; a factor with levels boy, girl.

schgend Schools' gender; a factor with levels corresponding to mixed school (mixedsch), boys' school (boysch), and girls' school (girlsSch).

avslrt Average LRT score in school.

schav Average LRT score in school, coded into 3 categories: low = bottom 25%, mid = middle 50%, high = top 25%.

vrband Students' score in test of verbal reasoning at age 11, a factor with 3 levels: vb1 = top 25%, vb2 = middle 50%, vb3 = bottom 25%.

Details

The tutorial dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009), and is a subset of data from a much larger dataset of examination results from six inner London Education Authorities (school boards). The original analysis (Goldstein et al., 1993) sought to establish whether some secondary schools had better student exam performance at 16 than others, after taking account of variations in the characteristics of students when they started secondary school; i.e., the analysis investigated the extent to which schools 'added value' (with regard to exam performance), and then examined what factors might be associated with any such differences. See also Rasbash et al. (2012) and Browne (2012).

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Goldstein, H., Rasbash, J., Yang, M., Woodhouse, G., Pan, H., Nuttall, D., Thomas, S. (1993) A multilevel analysis of school examination results. *Oxford Review of Education*, **19**, 425–433.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) *A User's Guide to MLwiN Version 2.26*. Centre for Multilevel Modelling, University of Bristol.

See Also

See `mLmRev` package for an alternative format of the same dataset.

Examples

```
## Not run:

data(tutorial, package = "R2MLwiN")

# Fit 2-level variance components model, using IGLS (default estimation method)
(VarCompModel <- runMLwiN(normexam ~ 1 + (1 | school) + (1 | student), data = tutorial))
```

```

# print variance partition coefficient (VPC)
print(VPC <- coef(VarCompModel)[["RP2_var_Intercept"]] /
      (coef(VarCompModel)[["RP1_var_Intercept"]] +
       coef(VarCompModel)[["RP2_var_Intercept"]]))

# Fit same model using MCMC
(VarCompMCMC <- runMLwiN(normexam ~ 1 + (1 | school) + (1 | student),
  estoptions = list(EstM = 1), data = tutorial))

# return diagnostics for VPC
VPC_MCMC <- VarCompMCMC@chains[, "RP2_var_Intercept"] /
  (VarCompMCMC@chains[, "RP1_var_Intercept"] +
   VarCompMCMC@chains[, "RP2_var_Intercept"])
sixway(VPC_MCMC, name = "VPC")

# Adding predictor, allowing its coefficient to vary across groups (i.e. random slopes)
(standlrtRS_MCMC <- runMLwiN(normexam ~ 1 + standlrt + (1 + standlrt | school) + (1 | student),
  estoptions = list(EstM = 1), data = tutorial))

# Example modelling complex level 1 variance
# fit log of precision at level 1 as a function of predictors
(standlrtC1V_MCMC <- runMLwiN(normexam ~
  1 + standlrt + (school | 1 + standlrt) + (1 + standlrt | student),
  estoptions = list(EstM = 1, mcmcMeth = list(lclo = 1)),
  data = tutorial))

## End(Not run)

```

 Untoggle

Converts a categorical variable into several separate binary variables

Description

This function converts a vector (factor) of categorical character strings (integers) into several separate vectors of binary indicators to enable back-compatibility with versions of **R2MLwiN** prior to 0.8-0.

Usage

```
Untoggle(categrv, name = NULL)
```

Arguments

categrv	A vector (factor) of categorical character strings (integers).
name	A character string specifying a name of a prefix to be appended the categories when generating dummy variables. If NULL, <code>v__</code> is used as a prefix.

Value

A matrix containing the generated dummy variables.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: Assumes MLwiN path is C:/Program Files (x86)/MLwiN v2.30/
# ...so please change relevant line if different
# if using R2MLwiN via WINE, the path may look like
# options(MLwiN_path='/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN v2.30/')

# Example: tutorial
data(tutorial)
names(tutorial)
tutorial = cbind(tutorial, Untoggle(tutorial$school, 'school'))
names(tutorial)

## End(Not run)
```

update,mlwinfitIGLS-method

Update "mlwinfitIGLS" objects

Description

Update "mlwinfitIGLS" objects

Usage

```
## S4 method for signature 'mlwinfitIGLS'
update(
  object,
  Formula.,
  levID.,
  estoptions.,
  ...,
  keep.order = TRUE,
  evaluate = TRUE
)
```

Arguments

object	a valid mlwinfitIGLS class object with an R function call component named call, the expression used to create itself.
Formula.	changes to the formula. This is a two sided formula where "." is substituted for existing components in the Formula component of object\$call.
levID.	changes to the specifications of level ID(s).
estoptions.	changes to the specifications of a list of options used for estimating the model.
...	additional arguments to the call, or arguments with changed values.
keep.order	a logical value indicating whether the terms should keep their positions.
evaluate	if TRUE (the default) the new call is evaluated; otherwise the call is returned as an unevaluated expression.

Value

either a new updated mlwinfitIGLS class object, or else an unevaluated expression for creating such an object.

See Also

[update-methods](#)

update,mlwinfitMCMC-method

Update "mlwinfitMCMC" objects

Description

Update "mlwinfitMCMC" objects

Usage

```
## S4 method for signature 'mlwinfitMCMC'  
update(  
  object,  
  Formula.,  
  levID.,  
  estoptions.,  
  ...,  
  keep.order = TRUE,  
  evaluate = TRUE  
)
```

Arguments

object	a valid mlwinfitMCMC class object with an R function call component named call, the expression used to create itself.
Formula.	changes to the formula. This is a two sided formula where "." is substituted for existing components in the Formula component of object\$call.
levID.	changes to the specifications of level ID(s).
estoptions.	changes to the specifications of a list of options used for estimating the model.
...	additional arguments to the call, or arguments with changed values.
keep.order	a logical value indicating whether the terms should keep their positions.
evaluate	if TRUE (the default) the new call is evaluated; otherwise the call is returned as an unevaluated expression.

Value

either a new updated mlwinfitMCMC class object, or else an unevaluated expression for creating such an object.

See Also

[update-methods](#)

update.mlwinfitIGLS *Update "mlwinfitIGLS" objects*

Description

Update "mlwinfitIGLS" objects

Usage

```
## S3 method for class 'mlwinfitIGLS'
update(object, ...)
```

Arguments

object	a valid mlwinfitIGLS class object with an R function call component named call, the expression used to create itself.
...	additional arguments to the call, or arguments with changed values.

Value

either a new updated mlwinfitIGLS class object, or else an unevaluated expression for creating such an object.

See Also

[update](#)

update.mlwinfitMCMC *Update "mlwinfitMCMC" objects*

Description

Update "mlwinfitMCMC" objects

Usage

```
## S3 method for class 'mlwinfitMCMC'
update(object, ...)
```

Arguments

object	a valid mlwinfitMCMC class object with an R function call component named call, the expression used to create itself.
...	additional arguments to the call, or arguments with changed values.

Value

either a new updated mlwinfitMCMC class object, or else an unevaluated expression for creating such an object.

See Also

[update](#)

vcov.mlwinfitIGLS-method

Extract the approximate variance-covariance matrix from "mlwinfit-IGLS" objects

Description

Extract the approximate variance-covariance matrix from "mlwinfitIGLS" objects

Usage

```
## S4 method for signature 'mlwinfitIGLS'
vcov(object, ...)
```

Arguments

object	An mlwinfitIGLS-class object
...	Other arguments

See Also[vcov-methods](#)

`vcov.mlwinfitMCMC-method`*Extract the approximate variance-covariance matrix from "mlwinfitMCMC" objects*

Description

Extract the approximate variance-covariance matrix from "mlwinfitMCMC" objects

Usage

```
## S4 method for signature 'mlwinfitMCMC'
vcov(object, ...)
```

Arguments

<code>object</code>	An mlwinfitMCMC-class object
<code>...</code>	Other arguments

See Also[vcov-methods](#)

`vcov.mlwinfitIGLS`*Extract the approximate variance-covariance matrix from "mlwinfitIGLS" objects*

Description

Extract the approximate variance-covariance matrix from "mlwinfitIGLS" objects

Usage

```
## S3 method for class 'mlwinfitIGLS'
vcov(object, ...)
```

Arguments

<code>object</code>	An mlwinfitIGLS-class object
<code>...</code>	Other arguments

See Also[vcov](#)

vcov.mlwinfitMCMC	<i>Extract the approximate variance-covariance matrix from "mlwinfitMCMC" objects</i>
-------------------	---

Description

Extract the approximate variance-covariance matrix from "mlwinfitMCMC" objects

Usage

```
## S3 method for class 'mlwinfitMCMC'
vcov(object, ...)
```

Arguments

object	An <code>mlwinfitMCMC</code> -class object
...	Other arguments

See Also

[vcov](#)

wage1	<i>Simulated dataset of office workers' salary and other employment details.</i>
-------	--

Description

A simulated dataset of office workers' salary (and associated information) in which workers exhibit multiple membership of companies worked for over past year.

Usage

```
wage1
```

Format

A data frame with 3022 observations on the following 21 variables:

id Unique office worker identifying code.

company Identifying code for company worked for over the last 12 months.

company2 If worked for >1 company over the last 12 months, identifying code for second company.

company3 If worked for >2 companies over the last 12 months, identifying code for third company.

- company4** If worked for >3 companies over the last 12 months, identifying code for fourth company.
- age** Age of worker.
- parttime** Part or full-time, a factor with levels Fulltime and Parttime.
- sex** Sex of worker, a factor with levels male and female.
- cons** A column of ones. If included as an explanatory variable in a regression model (e.g. in MLwiN), its coefficient is the intercept.
- earnings** Workers' earnings over the last financial year.
- logearn** Workers' (natural) log-transformed earnings over the last financial year.
- numjobs** The number of companies worked for over the last 12 months.
- weight1** Proportion of time worked for employer listed in company.
- weight2** Proportion of time worked for employer listed in company2.
- weight3** Proportion of time worked for employer listed in company3.
- weight4** Proportion of time worked for employer listed in company4.
- ew1** Alternative (equal) weighting for company (1/numjobs).
- ew2** Alternative (equal) weighting for company2 (if numjobs >1 then 1/numjobs, else 0).
- ew3** Alternative (equal) weighting for company3 (if numjobs >2 then 1/numjobs, else 0).
- ew4** Alternative (equal) weighting for company4 (if numjobs >3 then 1/numjobs, else 0).
- age_40** Age of worker, centered on 40 years.

Details

The simulated wage1 dataset is one of the sample datasets provided with the multilevel modelling software package MLwiN (Rasbash et al., 2009), and described in Browne (2012). It consists of salary and associated information for office workers, and is used by Browne (2012) as an example of modelling a multiple membership structure. The dataset exhibits multiple membership in that workers are clustered across the companies employing them over the past year, but some have worked for more than one company during that time.)

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

Examples

```
## Not run:

data(wage1, package = "R2MLwiN")

(mymodel <- runMLwiN(logearn ~ 1 + age_40 + numjobs + (1 | company) + (1 | id),
  estoptions = list(EstM = 1,
```

```
mm = list(list(mmvar = list("company", "company2", "company3", "company4"),
weights = list("weight1", "weight2", "weight3", "weight4")), NA)),
data = wage1))
```

```
## End(Not run)
```

write.IGLS	<i>Writes MLwiN macros to fit models using the iterative generalized least squares (IGLS) algorithm.</i>
------------	--

Description

write.IGLS is an internal function which creates an MLwiN macro file to fit a multilevel model using IGLS.

Usage

```
write.IGLS(
  indata,
  dtafile,
  oldsyntax = FALSE,
  resp,
  levID,
  expl,
  rp,
  D = "Normal",
  nonlinear = c(0, 1),
  categ = NULL,
  notation = NULL,
  nonfp = NA,
  clre = NULL,
  Meth = 1,
  extra = FALSE,
  reset,
  rcon = NULL,
  fcon = NULL,
  maxiter = 20,
  convtol = 2,
  mem.init = "default",
  optimat = FALSE,
  weighting = NULL,
  fpsandwich = FALSE,
  rpsandwich = FALSE,
  macrofile,
  IGLSfile,
```

```

  resifile,
  resi.store = FALSE,
  resioptions,
  debugmode = FALSE,
  startval = NULL,
  namemap = sapply(colnames(indata), as.character),
  saveworksheet = NULL,
  rng.version = 10
)

```

Arguments

<code>indata</code>	A data.frame object containing the data to be modelled.
<code>dtacfile</code>	The name of the temporary file used to send the data to MLwiN, which is in Stata format (i.e. with extension .dta).
<code>oldsyntax</code>	Specified as FALSE if new syntax has been used in Formula object, else specified as TRUE (to enable back-compatibility).
<code>resp</code>	A character string (vector) of the response variable name(s).
<code>levID</code>	A character string (vector) of the specified level ID name(s). The ID(s) should be sorted in the descending order of levels (e.g. <code>levID = c('level2', 'level1')</code> where 'level2' is the higher level).
<code>expl</code>	A character string (vector) of explanatory (predictor) variable name(s).
<code>rp</code>	A character string (vector) of random part of random variable name(s).
<code>D</code>	A character string/vector specifying the type of distribution to be modelled, which can include 'Normal' (the default), 'Binomial', 'Poisson', 'Negbinom', 'Unordered Multinomial', 'Ordered Multinomial', 'Multivariate Normal', or 'Mixed'. In the case of the latter, 'Mixed' precedes the response types which also need to be listed in D, e.g. <code>c('Mixed', 'Normal', 'Binomial')</code> ; these need to be listed in the same order to which they are referred to in the Formula object (see runMLwiN , Formula.translate , Formula.translate.compat . 'Mixed' combinations can consist of 'Normal' and 'Binomial' or 'Normal' and 'Poisson'.
<code>nonlinear</code>	A character vector specifying linearisation method for discrete response models (see Chapter 9 of Rasbash et al 2012, and Goldstein 2011). $N = 0$ specifies marginal quasi-likelihood linearization (MQL), whilst $N = 1$ specifies penalised quasi-likelihood linearization (PQL); $M = 1$ specifies first order approximation, whilst $M = 2$ specifies second order approximation. <code>nonlinear = c(N = 0, M = 1)</code> by default. First order marginal quasi-likelihood (MQL1) only option for single-level discrete response models.
<code>categ</code>	Specifies categorical variable(s) as a matrix. Each column corresponds to a categorical variable; the first row specifies the name(s) of variable(s); the second row specifies the name(s) of reference group(s), NA(s) if no reference group; the third row states the number of categories for each variable. Supports back-compatibility with R2MLwiN versions <0.8-0.
<code>notation</code>	Specifies the model subscript notation to be used in the MLwiN equations window. 'class' means no multiple subscripts, whereas 'level' has multiple subscripts.

nonfp	Removes the fixed part of random variable(s). NA if no variable to be removed.
clre	A matrix used to define which elements of the random effects matrix to remove (i.e. hold constant at zero). Removes from the random part at level <first row> the covariance matrix element(s) defined by the pair(s) of rows <second row> <third row>. Each column corresponds to a removed entry of the covariance matrix. See e.g. <code>demo(UserGuide07)</code> for an example.
Meth	Specifies which maximum likelihood estimation method to be used. If <code>Meth = 0</code> estimation method is set to RIGLS. If <code>Meth = 1</code> estimation method is set to IGLS (the default setting).
extra	If TRUE, extra binomial, extra negative binomial, extra Poisson or extra multinomial distributions assumed, else FALSE.
reset	A vector of length(<code>levID</code>) specifying the action to be taken, at each level, if a variance parameter is estimated at a particular iteration to be negative during estimation. Values specified in ascending order of level hierarchy: if 0 a negative variance estimate is reset to zero and so are any associated covariances; if 1 a negative variance estimate is reset to zero but not the associated covariances; if 2 no resetting takes place. E.g. <code>reset = c(0, 1)</code> to assign value 0 to level 1 and value 1 to level 2 of two-level model.
rcon	Matrix specifying constraints on the random parameters as specified in <code>random.ui</code> and <code>random.ci</code> in the <code>constraints</code> option within <code>estoptions</code> (see <code>runMLwiN</code>). <code>random.ci</code> is appended to the bottom row of <code>random.ui</code> .
fcon	Matrix specifying constraints on the fixed coefficients as specified in <code>fixed.ui</code> and <code>fixed.ci</code> in the <code>constraints</code> option within <code>estoptions</code> (see <code>runMLwiN</code>). <code>fixed.ci</code> is appended to the bottom row of <code>fixed.ui</code> .
maxiter	Numeric value specifying the maximum number of iterations, from the start, before estimation halts.
convtol	Numeric value specifying the convergence criterion, as specified in the <code>tol</code> option within <code>estoptions</code> (see <code>runMLwiN</code>). If value of <code>convtol</code> is <code>m</code> , estimation will be deemed to have converged when the relative change in the estimate for all parameters from one iteration to the next is less than $10(-m)$. Defaults to value of 2 for <code>m</code> if not otherwise specified.
mem.init	If calling <code>write.IGLS</code> directly, if wish to use defaults, value needs to be specified as 'default', else specify a vector of length 5 corresponding to the following order: number of levels; worksheet size in thousands of cells; the number of columns; the number of explanatory variables; the number of group labels.
optimat	This option instructs MLwiN to limit the maximum matrix size that can be allocated by the (R)IGLS algorithm. Specify <code>optimat = TRUE</code> if MLwiN gives the following error message 'Overflow allocating smatrix'. This error message arises if one more higher-level units is extremely large (contains more than 800 lower-level units). In this situation R2MLwiN 's default behaviour is to instruct MLwiN to allocate a larger matrix size to the (R)IGLS algorithm than is currently possible. Specifying <code>optimat = TRUE</code> caps the maximum matrix size at 800 lower-level units, circumventing the MLwiN error message, and allowing most MLwiN functionality.

weighting	A list of two items, one of which is a list called <code>weightvar</code> the length of which corresponds to the number of levels in the model, in descending order from highest level first. The other is an option <code>standardised</code> which is TRUE or FALSE.
fpsandwich	Specifies standard error type for fixed parameters. If <code>fpsandwich = TRUE</code> , robust or 'sandwich' standard errors based on raw residuals are used, if <code>fpsandwich = FALSE</code> (default) then standard, uncorrected, IGLS or RIGLS computation used.
rpsandwich	Specifies standard error type for random parameters. If <code>rpsandwich = TRUE</code> , robust or 'sandwich' standard errors based on raw residuals are used, if <code>rpsandwich = FALSE</code> (default) then standard, uncorrected, IGLS or RIGLS 'plug in' estimates used.
macrofile	A file name where the MLwiN macro file will be saved. The default location is in the temporary folder.
IGLSfile	A file name where the parameter estimates will be saved. The default location is in the temporary folder.
resifile	A file name where the residuals will be saved. The default location is in the temporary folder.
resi.store	A logical value to indicate if the residuals are to be stored (TRUE) or not (FALSE).
resioptions	A string vector to specify the various residual options. The 'variances' option calculates the posterior variances instead of the posterior standard errors; the 'standardised', 'leverage', 'influence' and 'deletion' options calculate standardised, leverage, influence and deletion residuals respectively; the 'sampling' option calculates the sampling variance covariance matrix for the residuals; the 'norecode' option prevents residuals with values exceedingly close or equal to zero from being recoded to missing; the <code>reflate</code> option returns unshrunk residuals. Note that the default option is <code>resioptions = c('variance')</code> ; 'variance' cannot be used together with the other options to calculate standardised, leverage, influence and deletion residuals.
debugmode	A logical value determining whether MLwiN is run in the background or not. The default value is FALSE: i.e. MLwiN is run in the background. If TRUE the MLwiN GUI is opened, and then pauses after the model has been set-up, allowing user to check starting values; pressing 'Resume macro' will then fit the model. Once fit, pressing 'Resume macro' once more will save the outputs to the <code>workdir</code> ready to be read by R2MLwiN . Users can instead opt to 'Abort macro' in which case the outputs are not saved to the <code>workdir</code> . This option currently works for 32 bit version of MLwiN only (automatically switches unless <code>MLwiNPath</code> or <code>options(MLwiNPath)</code> has been set directly to the executable).
startval	A list of numeric vectors specifying the starting values. <code>FP.b</code> corresponds to the estimates for the fixed part; <code>FP.v</code> specifies the variance/covariance estimates for the fixed part; <code>RP.b</code> specifies the variance estimates for the random part; <code>RP.v</code> corresponds to the variance/covariance matrix of the variance estimates for the random part.
namemap	A mapping of column names to DTA friendly shorter names
saveworksheet	A file name used to store the MLwiN worksheet after the model has been estimated.
rng.version	An integer indicating which random number generator should be used by MLwiN.

Value

Outputs a modified version of namemap containing newly generated short names.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

References

Goldstein, H. (2011) Multilevel Statistical Models. 4th Edition. London: John Wiley and Sons.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) A User's Guide to MLwiN Version 2.26. Centre for Multilevel Modelling, University of Bristol.

See Also

[write.MCMC](#)

write.MCMC

Writes MLwiN macros to fit models using Markov chain Monte Carlo (MCMC) methods

Description

write.MCMC is an internal function which creates an MLwiN macro file to fit models using MCMC.

Usage

```
write.MCMC(
  indata,
  dtafile,
  oldsyntax = FALSE,
  resp,
  levID,
  expl,
  rp,
  D = "Normal",
  nonlinear = c(0, 1),
  categ = NULL,
  notation = NULL,
  nonfp = NULL,
  clre = NULL,
  Meth = 1,
  merr = NULL,
  carcentre = FALSE,
  maxiter = 20,
  convtol = 2,
```

```
seed = 1,
iterations = 5000,
burnin = 500,
scale = 5.8,
thinning = 1,
priorParam = "default",
refresh = 50,
fixM = 1,
residM = 1,
Lev1VarM = 1,
OtherVarM = 1,
adaption = 1,
priorcode = c(gamma = 1),
rate = 50,
tol = 10,
lclo = 0,
mcmcOptions,
fact = NULL,
xc = NULL,
mm = NULL,
car = NULL,
BUGO = NULL,
mem.init = "default",
optimat = FALSE,
modelfile,
initfile,
datafile,
macrofile,
IGLSfile,
MCMCfile,
chainfile,
MIfile,
resifile,
resi.store = FALSE,
resioptions,
resichains,
FACTchainfile,
resi.store.levs = NULL,
debugmode = FALSE,
startval = NULL,
dami = NULL,
namemap = sapply(colnames(indata), as.character),
saveworksheet = NULL,
rng.version = 10
)
```

Arguments

`indata` A data.frame object containing the data to be modelled.

dtafile	The file name of the dataset to be imported into MLwiN, which is in Stata format (i.e. with extension .dta).
oldsyntax	Specified as FALSE if new syntax has been used in Formula object, else specified as TRUE (to enable backcompatibility).
resp	A character string (vector) of response variable(s).
levID	A character string (vector) of the specified level ID(s). The ID(s) should be sorted in the descending order of levels (e.g. levID = c('level2', 'level1')) where 'level2' is the higher level).
expl	A character string (vector) of explanatory (predictor) variable(s).
rp	A character string (vector) of random part of random variable(s).
D	A character string/vector specifying the type of distribution to be modelled, which can include 'Normal' (the default), 'Binomial', 'Poisson', 'Unordered Multinomial', 'Ordered Multinomial', 'Multivariate Normal', or 'Mixed'. In the case of the latter, 'Mixed' precedes the response types which also need to be listed in D, e.g. c('Mixed', 'Normal', 'Binomial'); these need to be listed in the same order to which they are referred to in the Formula object (see runMLwiN , Formula.translate , Formula.translate.compat . 'Mixed' combinations can only consist of 'Normal' and 'Binomial' for MCMC estimation.
nonlinear	A character vector specifying linearisation method for IGLS starting values for discrete response models (see Chapter 9 of Rasbash et al 2012, and Goldstein 2011). N = 0 specifies marginal quasi-likelihood linearization (MQL), whilst N = 1 specifies penalised quasi-likelihood linearization (PQL); M = 1 specifies first order approximation, whilst M = 2 specifies second order approximation. nonlinear = c(N = 0, M = 1) by default. First order marginal quasi-likelihood (MQL1) only option for single-level discrete response models.
categ	Specifies categorical variable(s) as a matrix. Each column corresponds to a categorical variable; the first row specifies the name(s) of variable(s); the second row specifies the name(s) of reference group(s), NA(s) if no reference group; the third row states the number of categories for each variable.
notation	Specifies the model subscript notation to be used in the MLwiN equations window. 'class' means no multiple subscripts, whereas 'level' has multiple subscripts.
nonfp	Removes the fixed part of random variable(s). NA if no variable is removed.
clre	A matrix used to estimate some, but not all, of the variances and covariances for a set of coefficients at a particular level. Remove from the random part at level <first row> the covariance matrix element(s) defined by the pair(s) of rows <second row> <third row>. Each row corresponds to a removed entry of the covariance matrix.
Meth	Specifies the maximum likelihood estimation method to be used when generating starting values via (R)IGLS. If Meth = 0 estimation method is set to RIGLS. If Meth = 1 estimation method is set to IGLS (the default setting). If Meth is absent, alternate between IGLS and RIGLS.
merr	A vector which sets-up measurement errors on predictor variables. The first element N defines the number of variables that have measurement errors. Then, for each variable with measurement error, a pair of inputs is required: the first

of which is the explanatory variable name as a character string, and the second of which is the variance of the measurement error for this variable. See `demo(MCMCGuide14)` for an example.

<code>carcentre</code>	If CAR model (i.e. if <code>car</code> is non-NULL), <code>carcentre = TRUE</code> mean-centres all random effects at that level.
<code>maxiter</code>	When generating starting values via (R)IGLS, a numeric value specifying the total number of iterations, from the start, before IGLS estimation halts (if <code>startval = NULL</code>).
<code>convtol</code>	When generating starting values via (R)IGLS, a numeric value specifying the IGLS convergence criterion, as specified in the <code>tol</code> option within <code>estoptions</code> , where <code>startval = NULL</code> (see <code>runMLwiN</code>). If value of <code>convtol</code> is <code>m</code> , estimation will be deemed to have converged when the relative change in the estimate for any parameter from one iteration to the next is less than $10(-m)$. Defaults to value of 2 for <code>m</code> if not otherwise specified.
<code>seed</code>	An integer specifying the random seed in <code>MLwiN</code> .
<code>iterations</code>	An integer specifying the number of iterations after burn-in.
<code>burnin</code>	An integer specifying length of the burn-in.
<code>scale</code>	An integer specifying the scale factor of proposed variances; this number will be multiplied by the estimated parameter variance (from IGLS/RIGLS) to give the proposal distribution variance.
<code>thinning</code>	An integer specifying the frequency with which successive values in the Markov chain are stored. By default <code>thinning = 1</code> .
<code>priorParam</code>	A vector specifying the informative priors used, as output from <code>prior2macro</code> .
<code>refresh</code>	An integer specifying how frequently the parameter estimates are refreshed on the screen during iterations; only applies if <code>debugmode = TRUE</code> in <code>estoptions</code> : see <code>runMLwiN</code> .
<code>fixM</code>	Specifies the fixed effect method: 1 for Gibbs Sampling, 2 for univariate MH Sampling and 3 for multivariate MH Sampling.
<code>residM</code>	Specifies the residual method: 1 for Gibbs Sampling, 2 for univariate MH Sampling and 3 for multivariate MH Sampling.
<code>Lev1VarM</code>	Specifies the level 1 variance method: 1 for Gibbs Sampling, 2 for univariate MH Sampling and 3 for multivariate MH Sampling.
<code>OtherVarM</code>	Specifies the variance method for other levels: 1 for Gibbs Sampling, 2 for univariate MH Sampling and 3 for multivariate MH Sampling.
<code>adaption</code>	<code>adaption = 1</code> indicates adaptation is to be used; \emptyset otherwise.
<code>priorcode</code>	A vector indicating which default priors are to be used for the variance parameters. It defaults to <code>c(gamma = 1)</code> in which case Gamma priors are used with <code>MLwiN</code> 's defaults of Gamma a value (shape) = 0.001 and Gamma b value (scale) = 0.001, although alternative values for shape and scale can be specified in subsequent elements of the vector, e.g. <code>c(gamma = 1, shape = 0.5, scale = 0.2)</code>). Alternatively <code>c(uniform = 1)</code> specifies Uniform priors on the variance scale. To allow for back-compatibility with deprecated syntax used in versions of <code>R2MLwiN</code> prior to 0.8-2, if <code>priorcode</code> is instead specified as an integer, then 1 indicates that Gamma priors are used, whereas \emptyset indicates that Uniform priors

are used. See the section on 'Priors' in the MLwiN help system for more details on the meaning of these priors.

rate	An integer specifying the acceptance rate (as a percentage); this command is ignored if <code>adaptation = 0</code> .
tol	An integer specifying tolerance (as a percentage) for the acceptance rate.
lclo	This command toggles on/off the possible forms of complex level 1 variation when using MCMC. <code>lclo = 0</code> expresses the level 1 variation as a function of the predictors, whereas <code>lclo = 1</code> expresses the log of the level 1 precision (1/variance) as a function of the predictors.
mcmcOptions	A list of other MCMC options used. See 'Details' below.
fact	A list of objects specified for factor analysis. See 'Details' below.
xc	Indicates whether model is cross-classified (TRUE) or nested (FALSE). <code>xc = NULL</code> by default (corresponding to FALSE), unless either <code>mm</code> or <code>car</code> are not null, in which case <code>xc = TRUE</code> .
mm	Specifies the structure of a multiple membership model. Can be a list of variable names, a list of vectors, or a matrix (e.g. see df2matrix). In the case of the former, each element of the list corresponds to a level (classification) of the model, in descending order. If a level is not a multiple membership classification, then NA is specified. Otherwise, lists need to be assigned to <code>mmvar</code> and <code>weights</code> , with the former containing columns specifying the classification units, and the latter containing columns specifying the weights. Ignored if <code>EstM = 0</code> , i.e. only applicable to models estimated via MCMC. <code>mm = NULL</code> by default. Supersedes deprecated <code>xclass</code> . E.g. (from <code>demo(MCMCGuide16)</code>) for <code>logearn ~ 1 + age_40 + sex + parttime + (company 1) + (id 1)</code> , if <code>company</code> is a multiple membership classification with the variables indicating the classifications in <code>company</code> , <code>company2</code> , <code>company3</code> , <code>company4</code> and their weights in <code>weight1</code> , <code>weight2</code> , <code>weight3</code> and <code>weight4</code> then <code>mm = list(list(mmvar = list('company', 'company2', 'company3', 'company4'), weights = list('weight1', 'weight2', 'weight3', 'weight4')), NA)</code> with the NA, listed last, corresponding to the level 1 identifier (<code>id</code>).
car	A list specifying structure of a conditional autoregressive (CAR) model. Each element of the list corresponds to a level (classification) of the model, in descending order. If a level is not a spatial classification, then NA is specified. Otherwise, lists need to be assigned to <code>carvar</code> and <code>weights</code> , with the former containing columns specifying the spatial classification units, and the latter containing columns specifying the weights. See <code>demo(MCMCGuide17)</code> for examples. <code>car = NULL</code> by default.
BUGO	If non-NULL uses BUGS for MCMC estimation using files specified in <code>modelfile</code> , <code>initfile</code> and <code>datafile</code> .
mem.init	A vector which sets and displays worksheet capacities for the current MLwiN session according to the value(s) specified. By default, the number of levels is <code>nlev+1</code> ; worksheet size in thousands of cells is 6000; the number of columns is 2500; the number of explanatory variables is <code>num_vars+10</code> ; the number of group labels is 20. <code>nlev</code> is the number of levels specified by <code>levID</code> , and <code>num_vars</code> is approximately the number of explanatory variables calculated initially.

optimat	This option instructs MLwiN to limit the maximum matrix size that can be allocated by the (R)IGLS algorithm. Specify <code>optimat = TRUE</code> if MLwiN gives the following error message 'Overflow allocating smatrix'. This error message arises if one more higher-level units is extremely large (contains more than 800 lower-level units). In this situation runmlwin's default behaviour is to instruct MLwiN to allocate a larger matrix size to the (R)IGLS algorithm than is currently possible. Specifying <code>optimat = TRUE</code> caps the maximum matrix size at 800 lower-level units, circumventing the MLwiN error message, and allowing most MLwiN functionality.
modelfile	A file name where the BUGS model will be saved in .txt format.
initfile	A file name where the BUGS initial values will be saved in .txt format.
datafile	A file name where the BUGS data will be saved in .txt format.
macrofile	A file name where the MLwiN macro file will be saved.
IGLSfile	A file name where the IGLS estimates will be saved.
MCMCfile	A file name where the MCMC estimates will be saved.
chainfile	A file name where the MCMC chains will be saved.
MIfile	A file name where the missing values will be saved.
resifile	A file name where the residual estimates will be saved.
resi.store	A logical value to indicate if residuals are to be stored (TRUE) or not (FALSE).
resioptions	A string vector to specify the various residual options. The 'variance' option calculates the posterior variances instead of the posterior standard errors; the 'standardised' option calculates standardised residuals.
resichains	A file name where the residual chains will be saved.
FACTchainfile	A file name where the factor chains will be saved.
resi.store.levs	An integer vector indicating the levels at which the residual chains are to be stored.
debugmode	A logical value determining whether MLwiN is run in the background or not. The default value is FALSE: i.e. MLwiN is run in the background. If TRUE the MLwiN GUI is opened, and then pauses after the model has been set-up, allowing user to check starting values; pressing 'Resume macro' will then fit the model. Once fit, pressing 'Resume macro' once more will save the outputs to the workdir ready to be read by R2MLwiN . Users can instead opt to 'Abort macro' in which case the outputs are not saved to the workdir. This option currently works for 32 bit version of MLwiN only (automatically switches unless <code>MLwiNPath</code> or <code>options(MLwiNPath)</code> has been set directly to the executable).
startval	A list of numeric vectors specifying the starting values when using MCMC. <code>FP.b</code> corresponds to the estimates for the fixed part; <code>FP.v</code> specifies the variance/covariance estimates for the fixed part; <code>RP.b</code> specifies the variance estimates for the random part; <code>RP.v</code> corresponds to the variance/covariance matrix of the variance estimates for the random part.
dami	This command outputs a complete (i.e. including non-missing responses) response variable <code>y</code> . If <code>dami = c(0, <iter1>, <iter2>, ...)</code> then the response

	variables returned will be the value of y at the iterations quoted (as integers $\langle \text{iter1} \rangle$, $\langle \text{iter2} \rangle$, etc.); these can be used for multiple imputation. If $\text{dami} = 1$ the value of y will be the mean estimate from the iterations produced. $\text{dami} = 2$ is as for $\text{dami} = 1$ but with the standard errors of the estimate additionally being stored.
namemap	A mapping of column names to DTA friendly shorter names
saveworksheet	A list of file names (one for each chain) used to store the MLwiN worksheet after the model has been estimated.
rng.version	An integer indicating which random number generator should be used by MLwiN.

Details

A list of other MCMC options as used in the argument `mcmcOptions`:

- `orth`: If `orth = 1`, orthogonal fixed effect vectors are used; zero otherwise.
- `hcen`: An integer specifying the level where we use hierarchical centering.
- `smcm`: If `smcm = 1`, structured MCMC is used; zero otherwise.
- `smvn`: If `smvn = 1`, the structured MVN framework is used; zero otherwise.
- `paex`: A matrix of $N \times 2$; in each row, if the second digit is 1, parameter expansion is used at level $\langle \text{the first digit} \rangle$.
- `mcco`: This command allows the user to have constrained settings for the lowest level variance matrix in a multivariate Normal model. If value is \emptyset , it estimates distinct variances for each residual error and distinct covariances for each residual error pair. Four other settings are currently available:
 - 1 fits structured errors with a common correlation parameter and a common variance parameter;
 - 2 fits AR1 errors with a common variance parameter;
 - 3 fits structured errors with a common correlation parameter and independent variance parameters;
 - 4 fits AR1 errors with independent variance parameters.

A list of objects specified for cross-classified and/or multiple membership models, as used in the argument `xclass`:

- `class`: An integer (vector) of the specified class(es).
- `N1`: This defines a multiple membership across $N1$ units at level `class`. $N1 > 1$ if there is multiple membership.
- `weight`: If there is multiple membership then the column number `weight`, which is the length of the dataset, will contain the first set of weights for the multiple membership. Note that there should be $N1$ weight columns and they should be sequential in the worksheet starting from `weight`.
- `id`: If the response is multivariate then the column number `id` must be input and this contains the first set of identifiers for the classification. Note that for a p -variate model each lowest level unit contains p records and the identifiers (sequence numbers) for each response variate need to be extracted into `id` and following columns. There should be $N1$ of these identifier columns and they should be sequential starting from `id` in the multivariate case.

- car: car = TRUE indicates the spatial CAR model; FALSE otherwise. car = FALSE if ignored.

A list of objects specified for factor analysis, as used in the argument fact:

- nfact: Specifies the number of factors
- lev.fact: Specifies the level/classification for the random part of the factor for each factor.
- nfactcor: Specifies the number of correlated factors
- factcor: a vector specifying the correlated factors: the first element corresponds to the first factor number, the second to the second factor number, the third element corresponds to the starting value for the covariance and the fourth element to whether this covariance is constrained (1) or not (0). If more than one pair of factors is correlated, then repeat this sequence for each pair.
- loading: A matrix specifying the starting values for the factor loadings and the starting value of the factor variance. Each row corresponds to a factor.
- constr: A matrix specifying indicators of whether the factor loadings and the factor variance are constrained (1) or not (0).

Value

Outputs a modified version of namemap containing newly generated short names.

Note

Note that for FixM, residM, Lev1VarM and

OtherVarM, not all combinations of methods are available for all sets of parameters and all models.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

References

Goldstein, H. (2011) Multilevel Statistical Models. 4th Edition. London: John Wiley and Sons.

Rasbash, J., Steele, F., Browne, W.J. and Goldstein, H. (2012) A User's Guide to MLwiN Version 2.26. Centre for Multilevel Modelling, University of Bristol.

See Also

[write.IGLS](#)

 ws2foreign

Converts data from one format to another within MLwiN

Description

This function converts data from one format to another within MLwiN, via MLwiN macro language. The foreign package allows R to read data files for most of these formats.

Usage

```
ws2foreign(wsfile, foreignfile, MLwiNPath = NULL, x64 = NULL)
```

Arguments

wsfile	A file name specifying the data file (with a specific extension) to be converted.
foreignfile	A file name specifying the data file (with a specific extension) after conversion.
MLwiNPath	A path to the MLwiN folder. By default, MLwiNPath = NULL and path set by options('MLwiN_path'), the default for which can be changed via options(MLwiN_path = 'path/to/MLwiN vX.XX/').
x64	A logical value indicating whether the 64 bit version of MLwiN is used, the default for this is determined by the version of R used. If FALSE, the 32 bit version is called.

Details

MLwiN supports conversion between MLwiN (*.wsz, *.ws), Minitab (*.mtw), SAS (*.xpt), SPSS (*.sav), and Stata (*.dta) files.

The converted data file (with a specific extension) will be saved to the file specified by foreignfile.

Author(s)

Zhang, Z., Charlton, C.M.J., Parker, R.M.A., Leckie, G., and Browne, W.J. (2016) Centre for Multilevel Modelling, University of Bristol.

See Also

[read.dta](#)

Examples

```
## Not run:
library(R2MLwiN)
# NOTE: if MLwiN not saved in location R2MLwiN defaults to, specify path via:
# options(MLwiN_path = 'path/to/MLwiN vX.XX/')
# If using R2MLwiN via WINE, the path may look like this:
# options(MLwiN_path = '/home/USERNAME/.wine/drive_c/Program Files (x86)/MLwiN vX.XX/')
```

```

wsfile = normalizePath(file.path(getOption("MLwiN_path"), "samples/tutorial.ws"), winslash = "/")
## the tutorial.dta file will be saved in the temporary folder
inputfile = normalizePath(file.path(tempdir(), "tutorial.dta"), winslash = "/", mustWork = FALSE)
ws2foreign(wsfile, foreignfile = inputfile)
library(foreign)
indata = read.dta(inputfile)
str(indata)
unlink(inputfile)

## End(Not run)

```

xc

*Examination scores of 16-year olds in Fife, Scotland.***Description**

A dataset of examination scores of 16-year olds in Fife, Scotland, in which the secondary school the pupil attended is cross-classified by the primary school the pupil attended.

Usage

xc

Format

A data frame with 3435 observations on the following 11 variables:

vrq A verbal reasoning score resulting from tests pupils took when they entered secondary school.

attain Attainment score of pupils at age sixteen.

pid Primary school identifying code.

sex Pupils' gender: a factor with levels Male and Female.

sc Pupils' social class (scaled from low to high).

sid Secondary school identifying code.

fed Fathers' education.

choice Choice number of secondary school attended (where 1 is first choice, etc.)

med Mothers' education.

cons A column of ones. If included as an explanatory variable in a regression model (e.g. in MLwiN), its coefficient is the intercept.

pupil Pupil identifying code.

Details

The xc dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009), analysed by Paterson (1991). The data are cross-classified in that not all children who attended the same primary school subsequently entered the same secondary school. See also Rasbash et al. (2012).

Source

Paterson, L. (1991) Socio economic status and educational attainment: a multidimensional and multilevel study. *Evaluation and Research in Education*, 5, 97-121. Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol. Rasbash, J., Steele, F., Browne, W.J., Goldstein, H. (2012) *A User's Guide to MLwiN v2.26*. University of Bristol: Centre for Multilevel Modelling.

See Also

See `mLmRev` package for an alternative format of the same dataset.

Examples

```
## Not run:

data(xc, package = "R2MLwiN")

(mymodel <- runMLwiN(attain ~ 1 + (1 | sid) + (1 | pid) + (1 | pupil),
  estoptions = list(xc = TRUE, EstM = 1), data = xc))

## End(Not run)
```

xc1

Examination scores of 16-year olds in Fife, Scotland.

Description

A dataset of examination scores of 16-year olds in Fife, Scotland, in which the secondary school the pupil attended is cross-classified by the primary school the pupil attended.

Usage

`xc1`

Format

A data frame with 3435 observations on the following 11 variables:

vrq A verbal reasoning score resulting from tests pupils took when they entered secondary school.

attain Attainment score of pupils at age sixteen.

pid Primary school identifying code.

sex Pupils' gender: a factor with levels Male and Female.

sc Pupils' social class (scaled from low to high).

sid Secondary school identifying code.

fed Fathers' education.

choice Choice number of secondary school attended (where 1 is first choice, etc.)

med Mothers' education.

cons A column of ones. If included as an explanatory variable in a regression model (e.g. in MLwiN), its coefficient is the intercept.

pupil Pupil identifying code.

Details

The xc1 dataset is one of the sample datasets provided with the multilevel-modelling software package MLwiN (Rasbash et al., 2009), analysed by Paterson (1991). The data are cross-classified in that not all children who attended the same primary school subsequently entered the same secondary school. See also Browne (2012).

Source

Browne, W. J. (2012) *MCMC Estimation in MLwiN Version 2.26*. University of Bristol: Centre for Multilevel Modelling.

Paterson, L. (1991) Socio economic status and educational attainment: a multidimensional and multilevel study. *Evaluation and Research in Education*, 5, 97-121.

Rasbash, J., Charlton, C., Browne, W.J., Healy, M. and Cameron, B. (2009) *MLwiN Version 2.1*. Centre for Multilevel Modelling, University of Bristol.

See Also

See `mLmRev` package for an alternative format of the same dataset.

Examples

```
## Not run:

data(xc1, package = "R2MLwiN")

(mymodel <- runMLwiN(attain ~ 1 + (1 | sid) + (1 | pid) + (1 | pupil),
  estoptions = list(xc = TRUE, EstM = 1), data = xc1))

## End(Not run)
```

```
[,mlwinfitIGLS,ANY,ANY,ANY-method
```

Extract or Replace parts of "mlwinfitIGLS" objects

Description

Extract or Replace parts of "mlwinfitIGLS" objects

Usage

```
## S4 method for signature 'mlwinfitIGLS,ANY,ANY,ANY'
x[i, j, drop]
```

```
## S4 replacement method for signature 'mlwinfitIGLS,ANY,ANY,ANY'
x[i, j] <- value
```

```
## S4 method for signature 'mlwinfitIGLS'
x[[i, j, drop]]
```

```
## S4 replacement method for signature 'mlwinfitIGLS'
x[[i, j]] <- value
```

Arguments

x	data frame
i, j	elements to extract or replace. For [, and [[, these are character.
drop	not used.
value	a suitable replacement value.

```
[,mlwinfitMCMC,ANY,ANY,ANY-method
```

Extract or Replace parts of "mlwinfitMCMC" objects

Description

Extract or Replace parts of "mlwinfitMCMC" objects

Usage

```
## S4 method for signature 'mlwinfitMCMC,ANY,ANY,ANY'
x[i, j, drop]
```

```
## S4 replacement method for signature 'mlwinfitMCMC,ANY,ANY,ANY'
x[i, j] <- value
```

```
## S4 method for signature 'mlwinfitMCMC'  
x[[i, j, drop]]  
  
## S4 replacement method for signature 'mlwinfitMCMC'  
x[[i, j]] <- value
```

Arguments

x	data frame
i, j	elements to extract or replace. For [and [[, these are character.
drop	not used.
value	a suitable replacement value.

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