Package 'lmeInfo'

February 2, 2021

Type Package

Title Information Matrices for 'lmeStruct' and 'glsStruct' Objects

Version 0.1.3

Description Provides analytic derivatives and information matrices for
fitted linear mixed effects (lme) models and generalized least squares (gls) models
estimated using lme() (from package 'nlme') and gls() (from package 'nlme'), respectively.
The package includes functions for estimating the sampling variance-covariance of variance
component parameters using the inverse Fisher information. The variance components include
the parameters of the random effects structure (for lme models), the variance structure,
and the correlation structure. The expected and average forms of the Fisher information matrix
are used in the calculations, and models estimated by full maximum likelihood or
restricted maximum likelihood are supported. The package also includes a function for estimating
standardized mean difference effect sizes (Puste-
jovsky, Hedges, and Shadish (2014) <DOI:10.3102/1076998614547577>)
based on fitted lme or gls models.

URL https://jepusto.github.io/lmeInfo/

BugReports https://github.com/jepusto/lmeInfo/issues

License GPL-3

Encoding UTF-8

LazyData true

Depends R (>= 3.5.0)

Suggests covr, testthat (>= 2.1.0), knitr, rmarkdown, scdhlm, dplyr,
tidyr, mlmRev, carData, lme4, merDeriv

Imports nlme, stats

VignetteBuilder knitr

RoxygenNote 7.1.1

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NeedsCompilation no

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R topics documented:

`Bryant2016` *Bryant et al. (2016)*

Description

Data from a multi-level multiple baseline design conducted by Bryant et al. (2016). The study involved collecting repeated measures of math performance on twelve students nested in three schools. The variables are as follows:

- `Study_ID` Study identifier.
- `school` School identifier.
- `case` Student identifier.
- `session` Measurement occasion.
- `treatment` Indicator for treatment phase.
- `outcome` Texas Early Mathematics Inventory (TEMI-Aim Check) scores.
- `trt_time` Measurement occasion times treatment phase.
- `session_c` Measurement occasion centered at the follow-up time (Measurement occasion 9).

Format

A data frame with 299 rows and 8 variables

Source

Bryant, B. R., Bryant, D. P., Porterfield, J., Dennis, M. S., Falcomata, T., Valentine, C., Brewer, C., & Bell, K. (2016). The effects of a Tier 3 intervention on the mathematics performance of second grade students with severe mathematics difficulties. *Journal of Learning Disabilities, 49*(2), 176-188. doi: 10.1177/0022219414538516

CI_g *Calculates a confidence interval for a standardized mean difference effect size*

Description

Calculates a confidence interval for a g_mlm object, using either a central t distribution (for a symmetric interval) or a non-central t distribution (for an asymmetric interval).

Usage

```
CI_g(g, cover = 0.95, bound = 35, symmetric = TRUE)
```

Arguments

g	an estimated effect size object of class g_mlm.
cover	confidence level.
bound	numerical tolerance for non-centrality parameter in qt.
symmetric	If TRUE (the default), use a symmetric confidence interval. If FALSE, use a non-central t approximation to obtain an asymmetric confidence interval.

Value

A vector of lower and upper confidence bounds.

Examples

```
library(nlme)
data(Bryant2016, package = "lmeInfo")
Bryant2016_RML1 <- lme(fixed = outcome ~ treatment,
                       random = ~ 1 | school/case,
                       correlation = corAR1(0, ~ session | school/case),
                       data = Bryant2016)
Bryant2016_g1 <- g_mlm(Bryant2016_RML1, p_const = c(0,1), r_const = c(1,1,0,1),
                       infotype = "expected", returnModel = TRUE)
CI_g(Bryant2016_g1, symmetric = TRUE)
CI_g(Bryant2016_g1, symmetric = FALSE)
```

extract_varcomp *Extract estimated variance components*

Description

Extracts the estimated variance components from a fitted linear mixed effects model (lmeStruct object) or generalized least squares model (glsStruct object).

Usage

```
extract_varcomp(mod)
```

Arguments

mod	Fitted model of class lmeStruct or glsStruct.

Value

Object of class `varcomp` consisting of a list of estimated variance components. Models that do not include correlation structure parameters or variance structure parameters will have empty lists for those components.

Examples

```
library(nlme)
data(Bryant2016)
Bryant2016_RML <- lme(fixed = outcome ~ treatment,
                      random = ~ 1 | school/case,
                      correlation = corAR1(0, ~ session | school/case),
                      data = Bryant2016)
extract_varcomp(Bryant2016_RML)
```

Fisher_info *Calculate expected, observed, or average Fisher information matrix*

Description

Calculates the expected, observed, or average Fisher information matrix from a fitted linear mixed effects model (lmeStruct object) or generalized least squares model (glsStruct object).

Usage

```
Fisher_info(mod, type = "expected")
```

Arguments

mod	Fitted model of class lmeStruct or glsStruct.
type	Type of information matrix. One of "expected" (the default), "observed", or "average".

Value

Information matrix corresponding to variance component parameters of mod.

Examples

```
library(nlme)
data(Bryant2016)
Bryant2016_RML <- lme(fixed = outcome ~ treatment,
                      random = ~ 1 | school/case,
                      correlation = corAR1(0, ~ session | school/case),
                      data = Bryant2016)
Fisher_info(Bryant2016_RML, type = "expected")
Fisher_info(Bryant2016_RML, type = "average")
```

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g_mlm *Calculates adjusted mlm effect size*

Description

Estimates a standardized mean difference effect size from a fitted multi-level model, using adjusted mlm method as described in Pustejovsky, Hedges, & Shadish (2014).

Usage

```
g_mlm(mod, p_const, r_const, infotype = "expected", returnModel = TRUE)
```

Arguments

mod	Fitted model of class lmeStruct (estimated using nlme::lme()) or of class glsStruct (estimated using nlme::gls()).
p_const	Vector of constants for calculating numerator of effect size. Must be the same length as fixed effects in mod.
r_const	Vector of constants for calculating denominator of effect size. Must be the same length as the number of variance component parameters in mod.
infotype	Type of information matrix. One of "expected" (the default), "observed", or "average".
returnModel	(Optional) If true, the fitted input model is included in the return. Defaults to TRUE so that summary() method returns more detail about the model parameters for an object of class g_mlm.

Value

A list with the following components

p_beta	Numerator of effect size
r_theta	Squared denominator of effect size
delta_AB	Unadjusted (mlm) effect size estimate
nu	Estimated denominator degrees of freedom
J_nu	Biased correction factor for effect size estimate
kappa	Scaled standard error of numerator
g_AB	Corrected effect size estimate
SE_g_AB	Approximate standard error estimate
cnvg_warn	Indicator that model did not converge
theta	Estimated variance component parameters
info_inv	Inversed information matrix

References

Pustejovsky, J. E., Hedges, L. V., & Shadish, W. R. (2014). Design-comparable effect sizes in multiple baseline designs: A general modeling framework. *Journal of Educational and Behavioral Statistics, 39*(4), 211-227. doi: 10.3102/1076998614547577

Examples

```
library(nlme)
data(Bryant2016, package = "lmeInfo")
Bryant2016_RML1 <- lme(fixed = outcome ~ treatment,
                       random = ~ 1 | school/case,
                       correlation = corAR1(0, ~ session | school/case),
                       data = Bryant2016)
Bryant2016_g1 <- g_mlm(Bryant2016_RML1, p_const = c(0,1), r_const = c(1,1,0,1),
                       infotype = "expected", returnModel = TRUE)
summary(Bryant2016_g1)
print(Bryant2016_g1)

data(Laski, package = "scdhlm")
Laski_AR1 <- gls(outcome ~ treatment,
                 correlation = corAR1(0.2, ~ time | case),
                 data = Laski)
Laski_AR1_g <- g_mlm(Laski_AR1, p_const = c(0,1), r_const = c(0,1),
                     infotype = "expected", returnModel = TRUE)
summary(Laski_AR1_g)
print(Laski_AR1_g)
```

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varcomp_vcov *Estimated sampling variance-covariance of variance component parameters.*

Description

Estimate the sampling variance-covariance of variance component parameters from a fitted linear mixed effects model (lmeStruct object) or generalized least squares model (glsStruct object) using the inverse Fisher information.

Usage

```
varcomp_vcov(mod, type = "expected")
```

Arguments

mod	Fitted model of class lmeStruct or glsStruct.
type	Type of information matrix. One of "expected" (the default), "observed", or "average".

Value

Sampling variance-covariance matrix corresponding to variance component parameters of mod.

Examples

```
library(nlme)
data(Bryant2016)
Bryant2016_RML <- lme(fixed = outcome ~ treatment,
                      random = ~ 1 | school/case,
                      correlation = corAR1(0, ~ session | school/case),
                      data = Bryant2016)
varcomp_vcov(Bryant2016_RML, type = "expected")
```

Index