Package ‘lmeInfo’

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**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 (Pustejovsky, Hedges, and Shadish (2014) <DOI:10.3102/1076998614547577>) based on fitted lme or gls models.

**URL** [https://jepusto.github.io/lmeInfo/](https://jepusto.github.io/lmeInfo/)

**BugReports** [https://github.com/jepusto/lmeInfo/issues](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

**Language** en-US

**NeedsCompilation** no

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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

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

```r
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

```r
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)
extriet_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

```r
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

```r
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.
inftype  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


Examples

```r
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")
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