Package ‘lmeInfo’

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Type Package

Title Information Matrices for ‘lmeStruct’ and ‘glsStruct’ Objects

Version 0.1.1

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

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 7.1.0

Language en-US

NeedsCompilation no

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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**

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**

```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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**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`.
- **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


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)
```

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

```r
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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