Package ‘varTestnlme’

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Type Package
Title Variance Components Testing for Linear and Nonlinear Mixed
   Effects Models
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URL http://github.com/baeyc/varTestnlme/
BugReports http://github.com/baeyc/varTestnlme/issues
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Description An implementation of the Likelihood ratio Test (LRT) for testing that,
in a (non)linear mixed effects model, the variances of a subset of the random
effects are equal to zero. There is no restriction on the subset of variances
that can be tested: for example, it is possible to test that all the variances
are equal to zero. Note that the implemented test is asymptotic.
This package should be used on model fits from packages ‘nlme’, 'lmer', and 'saemix'.
Charlotte Baey, Paul-
License GPL (>= 2)
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Imports mvtnorm, alabama, Matrix, merDeriv, matrixcalc, anocva,
corpcor, quadprog, lme4, nlme, saemix, msm, foreach, methods,
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approxWeights

Monte Carlo approximation of chi-bar-square weights

**Description**

Approximation of the chi-bar-square weights via Monte Carlo approximation.

**Usage**

```r
approxWeights(x, df, q)
```

**Arguments**

- `x` a vector of i.i.d. random realizations of the target chi-bar-square distribution
- `df` a vector containing the degrees of freedom of the chi-squared components
- `q` the empirical quantile of `x` used to choose the \( p - 2 \) values \( c_1, \ldots, c_{p-2} \) (see Details)

**Details**

The chi-bar-square distribution \( \bar{\chi}^2(I, C) \) is a mixture of chi-square distributions. The function provides a method to approximate the weights of the mixture components, when the number of components is known as well as the degrees of freedom of each chi-square distribution in the mixture, and given a vector of simulated values from the target \( \bar{\chi}^2(I, C) \) distribution. Let us assume that there are \( p \) components in the mixture, with degrees of freedom between \( n_1 \) and \( n_p \). By definition of a mixture distribution, we have:

\[
P(\chi^2(I, C) \leq c) = \sum_{i=n_1}^{n_p} w_i P(\chi_i^2 \leq c)
\]
Choosing \( p - 2 \) values \( c_1, \ldots, c_{p-2} \), the function will generate a system of \( p - 2 \) equations according to the above relationship, and add two additional relationships stating that the sum of all the weights is equal to 1, and that the sum of odd weights and of even weights is equal to 1/2, so that we end up with a system a \( p \) equations with \( p \) variables.

**Value**

A vector containing the estimated weights, as well as their covariance matrix.

**Author(s)**

Charlotte Baey <<charlotte.baey@univ-lille.fr>>

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**chiBarSquareObject-class**

*Class "chiBarSquareObject"*

---

**Description**

An object of the chiBarSquareObject class, storing the parameters of the chi-bar-square distribution.

**Slots**

- \( V \) a positive-definite matrix
- \( \text{dims} \) the set of dimensions defining the cone
- \( \text{orthant} \) logical, equals TRUE is the cone is the nonnegative orthant of \( \mathbb{R}^r \)

**Usage**

```r
# S4 method for signature 'chiBarSquareObject'
dfchisqbar(object)
```

**Arguments**

- \( \text{object} \) a chiBarSquareObject
**extractFIMnlme**  
*Extraction of the Fisher Information Matrix for nlme package*

### Description

Extraction of the Fisher Information Matrix for variance components fitted with nlme using Delta method.

### Usage

```r
extractFIMnlme(m, struct)
```

### Arguments

- `m`: a model fitted using nlme.
- `struct`: a string giving the structure of the covariance matrix: either `diag` for a diagonal matrix, `blockDiag` for a block diagonal matrix of `full` for a matrix with non-zero components.

### Details

This function extracts the FIM computed by the `nlme` for the transformed variance components, and uses the Delta method to compute the FIM for the natural variance components (i.e. variances and covariances).

### Value

- the FIM matrix for the variance components.

### Author(s)

Charlotte Baey (charlotte.baey@univ-lille.fr)

---

**pchiqbar**  
*pchiqbar*

### Description

- pchiqbar

### Usage

```r
## S4 method for signature 'numeric,chiBarSquareObject,logical'
pchiqbar(q, object, lower.tail = T)
```
plot.varTestObject

Arguments

- q: the quantile
- object: a chiBarSquareObject
- lower.tail: logical, default to TRUE

Description

Diagnostic plot for the approximation of the chi-bar-square distribution

Plot the empirical cumulative distribution function (cdf) of the simulated chi-bar-square distributed variable, along with the exact cdf of all the chi-square distributions involved in the mixture, and with the cdf based on the approximated weights. This function can only be used when the weights were approximated by simulation.

Arguments

- x: a object of class varTestObject obtained from a call to function varTest

print.varTestObject

Print basic information about the variance components test

Description

Displays the likelihood ratio test statistics and the p-value of the test

Arguments

- x: a object of class varTestObject obtained from a call to function varTest
summary.varTestObject  Summary information for the variance components test

Description

Displays the likelihood ratio test statistics, the limiting distribution and the p-value of the test

Arguments

x  a object of class varTestObject obtained from a call to function varTest

Value

a list containing the following elements:

- lrt  the likelihood ratio test statistics
- df  the degrees of freedom of the chi-bar distributions involved in the chi-bar-square distribution
- weights  the weights of the limiting chi-bar-square distribution
- pvalWeights  the p-value of the test calculated using the cdf of the chi-bar-square based on (approximated) weights
- pvalMC  the Monte-Carlo estimate of the p-value of the test based on the simulated chi-bar-square distribution

varTest  Variance component testing

Description

Perform a likelihood ratio test to test whether a subset of the variances of the random effects are equal to zero. The test is defined by two hypotheses, H0 and H1, and the model under H0 is assumed to be nested within the model under H1.

Usage

varTest(
  m1,  
m0,  
control = list(M = 5000),  
pval.comp = "bounds",  
fim = "extract"
)
Arguments

- **m1**: a fit of the model under H1, obtained from `nlme`, `lme4` or `saemix`.
- **m0**: a fit of the model under H0, obtained from the same package as `m0`.
- **control**: (optional) a list of control options for the computation of the chi-bar-weights.
- **pval.comp**: (optional) the method to be used to compute the p-value, one of: "bounds" (the default), "approx" or "both" (see Details section).
- **fim**: (optional) the method to compute the Fisher Information Matrix. Currently, only `fim="extract"` is supported.

Details

It is possible to tests if any subset of the variances are equal to zero. However, the function does not currently support nested random effects, and assumes that the random effects are Gaussian.

The asymptotic distribution of the likelihood ratio test is a chi-bar-square, with weights that need to be approximated by Monte Carlo methods, apart from some specific cases where they are available explicitly. Therefore, the p-value of the test is not exact but approximated. This computation can be time-consuming, so the default behaviour of the function is to provide bounds on the exact p-value, which can be enough in practice to decide whether to reject or not the null hypothesis. This is triggered by the option `pval.comp="bounds"`. To compute an approximation of the exact p-value, one should use the option `pval.comp="approx"` or `pval.comp="both"`.

The `control` argument controls the options for chi-bar-square weights computation. It is a list with the following elements: `M` the size of the Monte Carlo simulation, `parallel` a boolean for parallel computing and `nbcores` the number of cores to be used in case of parallel computing. Default is `M=5000, parallel=FALSE and nbcores=1`.

Value

A list with the following components:

- **lrt**: the likelihood ratio test statistics
- **ddl**: the degrees of freedom of the chi-bar distributions involved in the chi-bar-square distribution
- **weights**: the weights of the limiting chi-bar-square distribution
- **pval**: the p-value of the test

Author(s)

Charlotte Baey <<charlotte.baey@univ-lille.fr>>

References


Examples

```r
# load nlme package and example dataset
library(nlme)
data(Orthodont)

# fit the two models under H1 and H0
lm1.h1.nlme <- lme(distance ~ 1 + Sex + age + age*Sex, random = ~ 1 + age | Subject,
data = Orthodont, method = "ML")
lm1.h0.nlme <- lme(distance ~ 1 + Sex + age + age*Sex, random = ~ 1 | Subject,
data = Orthodont, method = "ML")

# compare them (order is important: m1 comes first)
varTest(lm1.h1.nlme, lm1.h0.nlme)
```

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### varTestnlme-internal

**Internal varTestnlme Functions**

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### varTestObject-class

**Class "varTestObject"**

---

**Description**

An object of the varTestObject class, storing the results of the LRT

**Slots**

- `lrt` the likelihood ratio test statistics
- `df` the degrees of freedom of the chi-square distributions involved in the mixture
- `weights` the weights associated to the chi-square distributions involved in the mixture
- `pvalue` the p-value of the LRT

**Objects from the Class**

An object of the varTestObject contains the following slots:
weightsChiBarSquare  

Chi-bar-square weights computation

Description

Computation of the chi-bar-square weights.

Usage

weightsChiBarSquare(cbs, control)

Arguments

cbs an object of class chiBarSquareObject, containing the parameters of the chi-bar-square distribution
control (optional) a list of control options for the computation of the chi-bar-weights

Details

The function computes an approximation of the weights of the chi-bar-square distribution $\bar{\chi}^2(I, C)$ arising as the limiting distribution of the likelihood ratio test statistics under the null hypothesis. More details can be found in the references listed below

Value

A list containing the degrees of freedom of the chi-bar distributions involved in the chi-bar-square, along with the associated weights.

Author(s)

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