

Package ‘merDeriv’

July 10, 2019

Title Case-Wise and Cluster-Wise Derivatives for Mixed Effects Models

Version 0.1-7

Description Compute case-wise and cluster-wise derivative for mixed effects models with respect to fixed effects parameter, random effect (co)variances, and residual variance.

Depends R (>= 3.2.3), lme4 (>= 1.1-10), stats, methods, nonnest2, sandwich, lavaan

Imports utils, Matrix

License GPL (>= 2)

LazyData yes

URL <http://semtools.r-forge.r-project.org>

NeedsCompilation no

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Repository CRAN

Date/Publication 2019-07-10 14:10:02 UTC

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bread.glmerMod	<i>Extract Bread Component for Huber-White Sandwich Estimator of Generalized Linear Mixed Effects Models</i>
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Description

This function calculates the bread component of the Huber-White sandwich estimator (variance covariance matrix multiplied by the number of clusters) for a generalized linear mixed effects model of class `glmerMod`.

Usage

```
## S3 method for class 'glmerMod'
bread(x, ...)
```

Arguments

`x` An object of class `glmerMod`.
`...` additional arguments, including `full` (`full = FALSE`; see details).

Value

A p by p "bread" matrix for the Huber-White sandwich estimator (variance-covariance matrix based on observed Fisher information multiplied by the number of clusters), where p represents the number of parameters. If `full = FALSE`, returns the variance-covariance matrix of only fixed effect parameters. If `full = TRUE`, returns the variance-covariance matrix for all fitted parameters (including fixed effect parameters, random effect (co)variances, and residual variance).

References

Douglas Bates, Martin Maechler, Ben Bolker, Steve Walker (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, **67**(1), 1-48. doi: [10.18637/jss.v067.i01](https://doi.org/10.18637/jss.v067.i01).
 Zeileis, A. (2006). Object-Oriented Computation of Sandwich Estimators. *Journal of Statistical Software*, **16**(9), 1-16. <http://www.jstatsoft.org/v16/i09/>

Examples

```
## Not run:
# The cbpp example
data(finance, package="smdata")

lme4fit <- glmer(corr ~ jmeth + (1 | item), data = finance,
               family = binomial, nAGQ = 20)

# bread component for all parameters
bread(lme4fit, full = TRUE)

## End(Not run)
```

bread.lmerMod	<i>Extract Bread Component for Huber-White Sandwich Estimator of Linear Mixed Effects Models</i>
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Description

This function calculates the bread component of the Huber-White sandwich estimator (variance covariance matrix multiplied by the number of clusters) for a linear mixed effects model of class `lmerMod`.

Usage

```
## S3 method for class 'lmerMod'  
bread(x, ...)
```

Arguments

x	An object of class <code>lmerMod</code> .
...	additional arguments, including <code>full</code> and <code>information</code> (<code>full = FALSE</code> and <code>information = "expected"</code> are default; see details).

Value

A p by p "bread" matrix for the Huber-White sandwich estimator (variance-covariance matrix multiplied by the number of clusters), where p represents the number of parameters. If `full = FALSE`, returns the variance-covariance matrix of only fixed effect parameters. If `full = TRUE`, returns the variance-covariance matrix for all fitted parameters (including fixed effect parameters, random effect (co)variances, and residual variance. If `information = "expected"`, the variance-covariance matrix is based on the inversion of Fisher information matrix. If `information = "observed"`, the variance-covariance matrix is based on the observed Fisher information, which is the negative of Hessian matrix.

References

Wang, T. & Merkle, E. C. (2018). Derivative Computations and Robust Standard Errors for Linear Mixed Effects Models in lme4. *Journal of Statistical Software*, **87**(1), 1-16. doi: [10.18637/jss.v087.c01](https://doi.org/10.18637/jss.v087.c01)

Zeileis, A. (2006). Object-Oriented Computation of Sandwich Estimators. *Journal of Statistical Software*, **16**(9), 1-16. <http://www.jstatsoft.org/v16/i09/>

Examples

```
## Not run:  
# The sleepstudy example  
lme4fit <- lmer(Reaction ~ Days + (Days|Subject), sleepstudy, REML = FALSE)  
  
# bread component for all parameters
```

```
bread(lme4fit, full = TRUE)

## End(Not run)
```

estfun.glmerMod	<i>Extract Cluster-wise Derivatives for Generalized Linear Mixed Effects Models</i>
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Description

A function for extracting the cluster-wise derivatives of a generalized linear mixed effects models fitted via **lme4**. This function returns the cluster-wise scores, evaluated at the ML estimates.

Usage

```
## S3 method for class 'glmerMod'
estfun(x, ...)
```

Arguments

x	An object of class <code>glmerMod</code> .
...	Additional arguments.

Value

A g by p score matrix, corresponding to g clusters and p parameters. For models with multiple clustering variables (three-level models, crossed random effects), an error is thrown.

References

Douglas Bates, Martin Maechler, Ben Bolker, Steve Walker (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, **67**(1), 1-48. doi: [10.18637/jss.v067.i01](https://doi.org/10.18637/jss.v067.i01).

Examples

```
## Not run:
data(finance, package="smdata")

lme4fit <- glmer(corr ~ jmeth + (1 | item), data = finance,
               family = binomial, nAGQ = 20)

# clusterwise scores
estfun(lme4fit)

## End(Not run)
```

estfun.lmerMod	<i>Extract Case-wise and Cluster-wise Derivatives for Linear Mixed Effects Models</i>
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Description

A function for extracting the case-wise and cluster-wise derivatives of a linear mixed effects models fitted via **lme4**. This function returns the case-wise and cluster-wise scores, evaluated at the ML estimates.

Usage

```
## S3 method for class 'lmerMod'  
estfun(x, ...)
```

Arguments

`x` An object of class `lmerMod`.
`...` additional arguments, including `level` (`level = 2` is default; see details).

Value

If `level = 2`, a g by p score matrix, corresponding to g clusters and p parameters. If `level = 1`, a n by p score matrix, corresponding to n observations and p parameters. For models with multiple clustering variables (three-level models, crossed random effects), an error is thrown if `level = 2`.

References

Wang, T. & Merkle, E. C. (2018). Derivative Computations and Robust Standard Errors for Linear Mixed Effects Models in lme4. *Journal of Statistical Software*, **87**(1), 1-16. doi: [10.18637/jss.v087.c01](https://doi.org/10.18637/jss.v087.c01)

Examples

```
## Not run:  
# The sleepstudy example  
lme4fit <- lmer(Reaction ~ Days + (Days|Subject), sleepstudy, REML = FALSE)  
  
# casewise scores  
estfun(lme4fit, level = 1)  
  
# clusterwise scores  
estfun(lme4fit, level = 2)  
  
## End(Not run)
```

llcont.glmMod	<i>Extract Cluster-wise Log Likelihoods for Generalized Linear Mixed Effects Models</i>
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Description

A function for extracting the cluster-wise log likelihoods of a generalized linear mixed effects model fitted via **lme4**. This function returns the cluster-wise log likelihoods, evaluated at the ML estimates.

Usage

```
## S3 method for class 'glmMod'  
llcont(x, ...)
```

Arguments

x	An object of class <code>glmMod</code> .
...	Additional arguments.

Value

A vector of log-likelihoods whose length is the number of clusters.

References

Douglas Bates, Martin Maechler, Ben Bolker, Steve Walker (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, **67**(1), 1-48. doi: [10.18637/jss.v067.i01](https://doi.org/10.18637/jss.v067.i01).

Merkle, E. C., You, D. and Preacher, K. J., 2016. Testing Nonnested Structural Equation Models. *Psychological Methods*, **21**(2), 151. <https://arxiv.org/pdf/1402.6720v3>

Examples

```
## Not run:  
data(finance, package="smdata")  
  
lme4fit <- glmer(corr ~ jmeth + (1 | item), data = finance,  
               family = binomial, nAGQ = 20)  
  
# clusterwise log likelihood  
llcont(lme4fit)  
  
## End(Not run)
```

llcont.lmerMod *Extract Case-wise Log Likelihoods for Linear Mixed Effects Models*

Description

A function for extracting the case-wise log likelihoods of a linear mixed effects model fitted via **lme4**. This function returns the case-wise log likelihoods, evaluated at the ML estimates.

Usage

```
## S3 method for class 'lmerMod'  
llcont(x, ...)
```

Arguments

x An object of class `lmerMod`.
... additional arguments, including `level` (`level = 2` is default; see details).

Value

If `level = 2`, a vector of log-likelihoods whose length is the number of clusters. If `level = 1`, a vector of length n , containing log-likelihoods for all n observations.

References

Wang, T. & Merkle, E. C. (2018). Derivative Computations and Robust Standard Errors for Linear Mixed Effects Models in lme4. *Journal of Statistical Software*, **87**(1), 1-16. doi: [10.18637/jss.v087.c01](https://doi.org/10.18637/jss.v087.c01)

Merkle, E. C., You, D. and Preacher, K. J., 2016. Testing Nonnested Structural Equation Models. *Psychological Methods*, **21**(2), 151. <https://arxiv.org/pdf/1402.6720v3>

Examples

```
## Not run:  
# The sleepstudy example  
lme4fit <- lmer(Reaction ~ Days + (Days|Subject), sleepstudy, REML = FALSE)  
  
# clusterwise log likelihood  
llcont(lme4fit)  
  
## End(Not run)
```

`vcov.glmerMod`*Extract Variance-Covariance Matrix of all Parameters for Generalized Linear Mixed Effects Models*

Description

This function calculates the variance-covariance matrix for all parameters (fixed and random effect) in a generalized linear mixed effects model of class `glmerMod`.

Usage

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

Arguments

`object` An object of class `glmerMod`.
`...` additional arguments, including `full` (`full = FALSE` is default; see details).

Value

A p by p variance-covariance matrix, where p represents the number of parameters. If `full = FALSE`, returns the variance-covariance matrix of only fixed effect parameters. If `full = TRUE`, returns the variance-covariance matrix for all fitted parameters (including fixed effect parameters and random effect (co)variances). The variance-covariance matrix is based on the negative of Hessian matrix, which is extracted from `lme4`.

References

Douglas Bates, Martin Maechler, Ben Bolker, Steve Walker (2015). Fitting Linear Mixed-Effects Models Using `lme4`. *Journal of Statistical Software*, **67**(1), 1-48. doi: [10.18637/jss.v067.i01](https://doi.org/10.18637/jss.v067.i01).

Examples

```
## Not run:  
# The cbpp example  
data(finance, package="smdata")  
  
lme4fit <- glmer(corr ~ jmeth + (1 | item), data = finance,  
               family = binomial, nAGQ = 20)  
  
# variance covariance matrix for all parameters  
vcov(lme4fit, full = TRUE)  
  
## End(Not run)
```

vcov.lmerMod	<i>Extract Variance-Covariance Matrix of all Parameters for Linear Mixed Effects Models</i>
--------------	---

Description

This function calculates the variance-covariance matrix for all parameters (fixed, random effect, and residual) in a linear mixed effects model of class `lmerMod`.

Usage

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

Arguments

<code>object</code>	An object of class <code>lmerMod</code> .
<code>...</code>	additional arguments, including <code>full</code> and <code>information</code> (<code>full = FALSE</code> and <code>information = "expected"</code> are default; see details).

Value

A p by p variance-covariance matrix, where p represents the number of parameters. If `full = FALSE`, returns the variance-covariance matrix of only fixed effect parameters. If `full = TRUE`, returns the variance-covariance matrix for all fitted parameters (including fixed effect parameters, random effect (co)variances, and residual variance. If `information = "expected"`, the variance-covariance matrix is based on the inversion of Fisher information matrix. If `information = "observed"`, the variance-covariance matrix is based on the observed Fisher information, which is the negative of Hessian matrix.

References

Wang, T. & Merkle, E. C. (2018). Derivative Computations and Robust Standard Errors for Linear Mixed Effects Models in lme4. *Journal of Statistical Software*, **87**(1), 1-16. doi: [10.18637/jss.v087.c01](https://doi.org/10.18637/jss.v087.c01)

Examples

```
## Not run:  
# The sleepstudy example  
lme4fit <- lmer(Reaction ~ Days + (Days|Subject), sleepstudy, REML = FALSE)  
  
# variance covariance matrix for all parameters  
vcov(lme4fit, full = TRUE)  
  
## End(Not run)
```

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