Package 'covBM'

October 12, 2022

Title Brownian Motion Processes for 'nlme'-Models

Version 0.1.0

Description Allows Brownian motion, fractional Brownian motion,
and integrated Ornstein-Uhlenbeck process components to
be added to linear and non-linear mixed effects models
using the structures and methods of the 'nlme' package.

Depends nlme (>= 3.0)

Imports stats

License GPL-3

NeedsCompilation yes

LazyData true

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cd4   *Serial CD4 counts in children with HIV.*

Description

Dataset used in *Data Analysis Using Regression and Multilevel/Hierarchical Models* by Andrew
Gelman and Jennifer Hill (Cambridge University Press, 2006). Rows with missing values of
'CD4CNT', 'visage' or 'baseage' have been removed.

Usage

```
cd4
```

Format

A data frame with 976 rows and 11 variables:

newpid Patient ID code.

t Time, in years from first visit.

sqrtcd4 Square root of CD4 count.

treatmnt Indicator variable for treatment, 1 represents control group and 2 indicates zinc treatment
group.

CD4CNT CD4 count on original (untransformed) scale.

baseage Age of child in years at initial visit.

visage Age of child in years at given visit.

Source

http://www.stat.columbia.edu/~gelman/arm/examples/cd4/

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coef.covBM	*coef.covBM*

Description

This is a method function that extracts the scale coefficient associated with a Brownian motion correlation structure object.

Usage

```
## S3 method for class 'covBM'
coef(object, unconstrained = TRUE, ...)
```

Arguments

object	An object of class covBM, inheriting from corStruct.
unconstrained	A logical value. If TRUE the coefficients are returned in unconstrained form (as used in the optimization algorithm). If FALSE the coefficients are returned in "natural" form.
...	Additional arguments (not used by this method).

Examples

```
cov1<-covBM(form=~time|group)
coef(cov1)
```

---

coef.covFracBM	*coef.covFracBM*

Description

This is a method function that extracts the scale coefficient and Hurst parameter associated with a fractional Brownian motion correlation structure object.

Usage

```
## S3 method for class 'covFracBM'
coef(object, unconstrained = TRUE, ...)
```

Arguments

object	An object of class covFracBM, inheriting from corStruct.
unconstrained	A logical value. If TRUE the coefficients are returned in unconstrained form (as used in the optimization algorithm). If FALSE the coefficients are returned in "natural" form.
...	Additional arguments (not used by this method).

Examples

```
cov2<-covFracBM(form=~time|group)
coef(cov2)
```

---

coef.covIOU   *coef.covIOU*

Description

This is a method function that extracts the perturbation and Alpha parameters associated with an integrated Ornstein-Uhlenbeck (IOU) process correlation structure object.

Usage

```
## S3 method for class 'covIOU'
coef(object, unconstrained = TRUE, ...)
```

Arguments

object	An object of class [covIOU](), inheriting from [corStruct]().
unconstrained	A logical value. If TRUE the coefficients are returned in unconstrained form (as used in the optimization algorithm). If FALSE the coefficients are returned in "natural" form.
...	Additional arguments (not used by this method).

Examples

```
cov3<-covIOU(form=~time|group)
coef(cov3)
```

---

corMatrix.covBM   *corMatrix.covBM*

Description

This method generates a scaled covariance matrix (or list of matrices), for a "covBM" "corStruct" object.

Usage

```
## S3 method for class 'covBM'
corMatrix(object, covariate = getCovariate(object), ...)
```

Arguments

object	An object of class covBM, inheriting from corStruct.
covariate	List of covariate vectors, at which values the correlation matrix, or list of correlation matrices, are to be evaluated, as for corMatrix.corStruct.
...	Additional arguments (not used by this method).

---

corMatrix.covFracBM   *corMatrix.covFracBM*

Description

This method generates a scaled covariance matrix (or list of matrices), for a "covFracBM" "corStruct" object.

Usage

```
## S3 method for class 'covFracBM'
corMatrix(object, covariate = getCovariate(object), ...)
```

Arguments

object	An object of class covFracBM, inheriting from corStruct.
covariate	List of covariate vectors, at which values the correlation matrix, or list of correlation matrices, are to be evaluated, as for corMatrix.corStruct.
...	Additional arguments (not used by this method).

---

corMatrix.covIOU   *corMatrix.covIOU*

Description

This method generates a scaled covariance matrix (or list of matrices), for a "covIOU" "corStruct" object.

Usage

```
## S3 method for class 'covIOU'
corMatrix(object, covariate = getCovariate(object), ...)
```

Arguments

object	An object of class covIOU, inheriting from corStruct.
covariate	List of covariate vectors, at which values the correlation matrix, or list of correlation matrices, are to be evaluated, as for corMatrix.corStruct.
...	Additional arguments (not used by this method).

---

covBM   *covBM*

Description

This is a constructor function for the "covBM" class, representing a Brownian motion component
in terms of a continuous variable. The object created is a special type of [corStruct](#).

covBM

Usage

```
covBM(value = 1, form = ~1)
```

Arguments

value	Numeric argument providing starting value for the scale parameter of Brownian motion process relative to residual error variance for optimisation.
form	A one-sided formula of the form ~t|g, where t represents a continuous variable (usually time) and g represents a grouping factor, i.e. with a separate Brownian motion process modelled at each level.

Value

An object of class "covBM" and inheriting from "corStruct".

Examples

```
cov1<-covBM(form=~time|group)
```

---

covFracBM   *covFracBM*

Description

This is a constructor function for the "covFracBM" class, representing a fractional Brownian motion
component in terms of a continuous variable. The object created is a special type of [corStruct](#).

Usage

```
covFracBM(value = c(1, 0.5), form = ~1)
```

Arguments

value   Vector of length 2 providing starting values for optimisation of the scale parameter of fractional Brownian motion process relative to residual error variance and the Hurst parameter, respectively.

form   A one-sided formula of the form ~t|g, where t represents a continuous variable (usually time) and g represents a grouping factor, i.e. with a separate fractional Brownian motion process modelled at each level.

Value

An object of class "covFracBM" and inheriting from "corStruct".

Examples

```
cov2<-covFracBM(form=~time|group)
```

---

covIOU   *covIOU*

Description

This is a constructor function for the "covIOU" class, representing an integrated Ornstein-Uhlenbeck (IOU) process component in terms of a continuous variable. The object created is a special type of [corStruct](#).

Usage

```
covIOU(value = c(1, 1), form = ~1)
```

Arguments

value   Vector of length 2 providing starting values for optimisation of the perturbation parameter of integrated Ornstein-Uhlenbeck process relative to residual error variance and the Alpha parameter, respectively.

form   A one-sided formula of the form ~t|g, where t represents a continuous variable (usually time) and g represents a grouping factor, i.e. with a separate integrated Ornstein-Uhlenbeck process modelled at each level.

Value

An object of class "covIOU" and inheriting from "corStruct".

Examples

```
cov3<-covIOU(form=~time|group)
```

---

lmeBM   *lmeBM*

Description

This function is a wrapper for `lme.formula` that allows Brownian motion, fractional Brownian motion or integrated Ornstein-Uhlenbeck components to be included in linear mixed models, with related parameter estimates and confidence intervals returned in their natural parameterisation.

Usage

```
lmeBM(fixed, data, random, covariance = NULL, method = c("REML", "ML"),
  control = list(), keep.data = TRUE)
```

Arguments

fixed	This is as specified for `lme.formula`.
data	This is as specified for `lme.formula`.
random	This is as specified for `lme.formula`.
covariance	An optional `corStruct` object describing the within-group covariance structure. In addition to those available in nlme, `covBM` can be used to incorporate a Brownian motion component, `covFracBM` can be used to incorporate a fractional Brownian motion component and `covIOU` can be used to incorporate an integrated Ornstein-Uhlenbeck process in relation to a continuous variable.
method	This is as specified for `lme.formula`.
control	This is as specified for `lme.formula`.
keep.data	This is as specified for `lme.formula`.

Value

An object of class "lme" representing the linear mixed effects model fit.

Examples

```
BMmodel<-lmeBM(sqrtcd4~t, data=cd4, random=~t|newpid, covariance=covBM(form=~t|newpid),
method="ML", control=list(opt="link{nlm}"))
```

---

nlmeBM   *nlmeBM*

Description

This function is a wrapper for `nlme.formula` that allows Brownian motion, fractional Brownian motion or integrated Ornstein-Uhlenbeck components to be included in non-linear mixed models, with related parameter estimates and confidence intervals returned in their natural parameterisation.

Usage

```
nlmeBM(model, data, fixed, random, start, covariance = NULL,
  method = c("ML", "REML"), control = list(), verbose = FALSE)
```

Arguments

`model`	This is as specified for `nlme.formula`.
`data`	This is as specified for `lme.formula`.
`fixed`	This is as specified for `lme.formula`.
`random`	This is as specified for `nlme.formula`.
`start`	This is as specified for `nlme.formula`.
`covariance`	An optional `corStruct` object describing the within-group covariance structure. In addition to those available in nlme, `covBM` can be used to incorporate a Brownian motion component, `covFracBM` can be used to incorporate a fractional Brownian motion component and `covIOU` can be used to incorporate an integrated Ornstein-Uhlenbeck process in relation to a continuous variable.
`method`	This is as specified for `lme.formula`.
`control`	This is as specified for `nlme.formula`.
`verbose`	This is as specified for `nlme.formula`.

Value

An object of class "nlme" and inheriting from class "lme" representing the non-linear mixed effects model fit.

Examples

```
data(Milk, package="nlme")
Model_fit<- nlmeBM(protein ~ SSasymp(Time, Asym, R0, lrc), data=Milk,
fixed = Asym + R0 + lrc ~ 1, random = Asym ~ 1|Cow,
covariance=covFracBM(form=~Time|Cow),
        start = c(Asym = 3.5, R0 = 4, lrc = -1))
```

---

print.summary.corStructBM

print.summary.corStructBM

Description

print.summary.corStructBM

Usage

```
## S3 method for class 'summary.corStructBM'
print(x, ...)
```

Arguments

x   An object of class "summary.corStructBM", containing information on fitted
            stochastic process component.

...   Additional arguments (not used for this method).

---

summary.covBM   *summary.covBM*

Description

summary.covBM

Usage

```
## S3 method for class 'covBM'
summary(object, structName = class(object)[1], ...)
```

Arguments

object   An object of class "covBM", containing information on fitted stochastic process
            component.

structName An optional character string defining the type of correlation structure associated
            with object, as for summary.corStruct. Defaults to class(object)[1].

...   Additional arguments (not used for this method).

summary.covFracBM   *summary.covFracBM*

Description

summary.covFracBM

Usage

```
## S3 method for class 'covFracBM'
summary(object, structName = class(object)[1], ...)
```

Arguments

object	An object of class "covFracBM", containing information on fitted stochastic process component.
structName	An optional character string defining the type of correlation structure associated with object, as for `summary.corStruct`. Defaults to class(object)[1].
...	Additional arguments (not used for this method).

summary.covIOU   *summary.covIOU*

Description

summary.covIOU

Usage

```
## S3 method for class 'covIOU'
summary(object, structName = class(object)[1], ...)
```

Arguments

object	An object of class "covIOU", containing information on fitted stochastic process component.
structName	An optional character string defining the type of correlation structure associated with object, as for `summary.corStruct`. Defaults to class(object)[1].
...	Additional arguments (not used for this method).

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