Package 'slim'

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Title Singular Linear Models for Longitudinal Data

Version 0.1.1

Description Fits singular linear models to longitudinal data. Singular linear models are useful when the number, or timing, of longitudinal observations may be informative about the observations themselves. They are described in Farewell (2010) <doi:10.1093/biomet/asp068>, and are extensions of the linear increments model <doi:10.1111/j.1467-9876.2007.00590.x> to general longitudinal data.

Depends R (>= 3.2.0), data.table (>= 1.9.6)

Imports stats, MASS (>= 7.3)

Suggests lme4 (>= 1.1), jmcm (>= 0.1.6.0), gee (>= 4.13-19), ggplot2 (>= 2.1.0), testthat (>= 1.0.2), knitr, rmarkdown

License GPL-3

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R topics documented:

`slim-package` *Singular linear models for longitudinal data.*

Description

The slim package fits singular linear models to longitudinal data. Singular linear models are useful when the number, or timing, of longitudinal observations may be informative about the observations themselves. They are described in Farewell (2010) <doi:10.1093/biomet/asp068>, and are extensions of the linear increments model of Diggle et al. (2007) <doi:10.1111/j.1467-9876.2007.00590.x> to general longitudinal data.

Details

The most important function is slim, whose formula interface is similar to that of lm.

See Also

`slim`

`coef.slim` *Extract Model Coefficients from Singular Linear Model*

Description

Extract Model Coefficients from Singular Linear Model

Usage

```
## S3 method for class 'slim'
coef(object, ...)
```

Arguments

`object`	an object of class 'slim', usually, a result of a call to 'slim'.
`...`	arguments passed to or from other methods.

Value

a vector of model coefficients.

`compute_laurent` *Laurent Expansion of Inverse of Linear Matrix Function*

Description

This function computes the first two terms of the Laurent expansion of the inverse of a linear matrix function.

Usage

```
compute_laurent(V, zapsmall = TRUE)
```

Arguments

`V`	for some integer m >= 1, an array of dimension (m, m, 2), where V[, , 1] is the intercept and V[, , 2] is the slope of the linear matrix function.
`zapsmall`	logical: should zapsmall be called on the result? Default TRUE.

Value

array of dimension (m, m, 2), where W[, , 1] corresponds to the exponent -1, and W[, , 2] corresponds to the exponent 0.

`confint.slim` *Confidence Intervals for Model Parameters from Singular Linear Model*

Description

Confidence Intervals for Model Parameters from Singular Linear Model

Usage

```
## S3 method for class 'slim'
confint(object, parm, level = 0.95, empirical = TRUE, ...)
```

Arguments

object	an object of class 'slim', usually, a result of a call to 'slim'.
parm	a specification of which parameters are to be given confidence intervals, either a vector of numbers or a vector of names. If missing, all parameters are considered.
level	the confidence level required.
empirical	logical indicating if empirical variances of y should be used in estimating standard errors (the default). Empirical standard errors should be used unless covariances have been well modelled.
...	arguments passed to or from other methods.

Value

A matrix (or vector) with columns giving lower and upper confidence limits for each parameter.

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dialysis *Renal Function in Three Groups of Peritoneal Dialysis Patients*

Description

Longitudinal data on the renal function of 116 patients observed on up to five different occasions.

Usage

```
dialysis
```

Format

A data.table with 116 rows and 5 variables:

id	patient identifier, a character string
group	treatment group identifier, a character string
vintage	days since starting dialysis, an integer
month	month of observation, an integer
renalfn	renal function of the patient at that month, numeric

Source

This data is derived from the Global Fluid Study. This part of the study was led by Dr James Chess and Prof. Nick Topley.

References

Lambie, M., Chess, J. et al. (2013). Independent effects of systemic and peritoneal inflammation on peritoneal dialysis survival. J Am Soc Nephrol, 24, 2071–80.

fitted.slim *Extract Model Fitted Values from Singular Linear Model*

Description

Extract Model Fitted Values from Singular Linear Model

Usage

```
## S3 method for class 'slim'
fitted(object, ...)
```

Arguments

object	an object of class 'slim', usually, a result of a call to 'slim'.
...	arguments passed to or from other methods.

Value

a vector of fitted values from the model fit.

fit_slim *Fitter Function for Singular Linear Models*

Description

This function computes the limiting solution to the estimating equation sum(x' V^-1 (y - x beta)) = 0 as the covariance V tends from V[, , 1] + V[, , 2] to V[, , 1].

Usage

```
fit_slim(x, V, y)
```

Arguments

x	list of design matrices, one for each subject, all having the same number of columns.
V	list of covariance arrays, one for each subject, matching the dimensions of y.
y	list of response vectors, one for each subject.

Value

a list with components coefficients (the limiting solution), residuals, fitted_values, vcov_empirical and vcov_modelled.

list_covariances *List Covariance Matrices for Every Subject*

Description

This function is generic, and methods exists for character, list, function, and various model fit classes.

Usage

```
list_covariances(obj, t)

## S3 method for class 'character'
list_covariances(obj, t)

## S3 method for class 'list'
list_covariances(obj, t)

## S3 method for class 'function'
list_covariances(obj, t)

## S3 method for class 'jmcmMod'
list_covariances(obj, t)

## S3 method for class 'lmerMod'
list_covariances(obj, t)
```

Arguments

obj	an R object of class character, function, or a model fit
t	list of vectors of observation times, one for each subject

Value

a list containing covariance matrices of appropriate dimensions

predict.slim *Model Predictions from Singular Linear Model*

Description

Model Predictions from Singular Linear Model

Usage

```
## S3 method for class 'slim'
predict(object, newdata, ...)
```

Arguments

object	an object of class 'slim', usually, a result of a call to 'slim'.
newdata	An optional data frame in which to look for variables with which to predict. If omitted, the fitted values are used.
...	arguments passed to or from other methods.

Value

a vector of model predictions.

---

print.slim *Print 'slim' Objects*

Description

'print' methods for class 'slim' and 'slim_summary'. 'print.slim_summary' differs only in its default value of 'empirical'.

Usage

```
## S3 method for class 'slim'
print(x, empirical = TRUE, digits = max(3,
  getOption("digits") - 3), signif.stars = getOption("show.signif.stars"),
  ...)

## S3 method for class 'slim_summary'
print(x, empirical = x$empirical, ...)
```

Arguments

x	an object of class 'slim' or 'slim_summary', as appropriate.
empirical	logical indicating if empirical variances of y should be used in estimating standard errors (the default). Empirical standard errors should be used unless covariances have been well modelled.
digits	minimal number of *significant* digits, see print.default.
signif.stars	logical. If TRUE, 'significance stars' are printed for each coefficient.
...	arguments passed to or from other methods.

Value

x, invisibly.

residuals.slim *Extract Model Residuals from Singular Linear Model*

Description

Extract Model Residuals from Singular Linear Model

Usage

```
## S3 method for class 'slim'
residuals(object, ...)
```

Arguments

object	an object of class 'slim', usually, a result of a call to 'slim'.
...	arguments passed to or from other methods.

Value

a vector of model residuals.

slim *Fit Singular Linear Models*

Description

Fit a singular linear model to longitudinal data.

Usage

```
slim(formula, data, covariance = "randomwalk", limit = ~1,
  contrasts = NULL)
```

Arguments

formula	a model formula for the fixed effects
data	a 'data.table' with two keys, respectively identifying subjects and observation times
covariance	an R object for which a 'list_covariances' method exists. Options include a character string such as "identity", "randomwalk" (the default), "brownian" or "pascal"; a list of covariance matrices; a function to be used in 'outer' and applied to the observation times; or a 'jmcmMod' or 'lmerMod' model fit.
limit	a one-sided model formula for the (thin) Cholesky factor of the limiting covariance matrix (default ~ 1, so the limiting covariance matrix is the matrix of ones)
contrasts	an optional list. See the 'contrasts.arg' argument of 'model.matrix.default'.

Value

an object of class 'slim'

Examples

```
slim_fit <- slim(renalfn ~ group + month, dialysis)
summary(slim_fit)

if(require("lme4")) {
  lmer_fit <- lmer(renalfn ~ group + month + (1 + month | id), dialysis)
  slim_fit <- slim(renalfn ~ 1 + group + month, dialysis, covariance = lmer_fit)
  summary(slim_fit)
  summary(slim_fit, empirical = FALSE)
}

if(require("jmcm")) {
  jmcm_fit <- jmcm(renalfn | id | month ~ group | 1, dialysis,
    triple = rep(2L, 3), cov.method = "mcd")
  slim_fit <- slim(renalfn ~ group + month, dialysis, covariance = jmcm_fit)
  summary(slim_fit)
  summary(slim_fit, empirical = FALSE)
}
```

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slim.methods *Methods for Singular Linear Model Fits*

Description

Methods for Singular Linear Model Fits

Arguments

object	an object of class 'slim', usually, a result of a call to 'slim'.
empirical	logical indicating if empirical variances of y should be used in estimating standard errors (the default). Empirical standard errors should be used unless covariances have been well modelled.
...	arguments passed to or from other methods.

summary.slim *Summarizing Singular Linear Model Fits*

Description

'summary' method for class 'slim'.

Usage

```
## S3 method for class 'slim'
summary(object, empirical = TRUE, ...)
```

Arguments

object	an object of class 'slim', usually, a result of a call to 'slim'.
empirical	logical indicating if empirical variances of y should be used in estimating standard errors (the default). Empirical standard errors should be used unless covariances have been well modelled.
...	arguments passed to or from other methods.

Value

an object with class c("slim_summary", "slim") and, in addition to the usual 'slim' components, coefficient_matrix (the matrix of estimated coefficients, standard errors, z- and p-values) and empirical (logical indicating if empirical standard errors have been used)

vcov.slim *Extract Variance-Covariance Matrix from a 'slim' Object*

Description

'vcov' method for class 'slim'.

Usage

```
## S3 method for class 'slim'
vcov(object, empirical = TRUE, ...)
```

Arguments

object	an object of class 'slim', usually, a result of a call to 'slim'.
empirical	logical indicating if empirical variances of y should be used in estimating standard errors (the default). Empirical standard errors should be used unless covariances have been well modelled.
...	arguments passed to or from other methods.

Value

a matrix of the estimated covariances between the parameter estimates.

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