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Description Functions for modeling the built environment

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R topics documented:

BayesDlm	2
coef.Dlm	2
coef.sims	3
coef.sims,BayesDlm-method	3
cr	4
dln	4
Dln-class	6
fitted.Dlm	7
fixef	7
FreqDlm	8
lag.basis	8
LagBasis	9
logLik.Dlm	9
omega	10
plot.Dlm	10
predict.Dlm	11
predict.LagBasis	11
ranef	11

residuals.Dlm	12
scaleMat	12
se.fixef	13
se.ranef	13
sigma.Dlm	14
simdata	14
SmoothLag	15
summary.Dlm	15
SummaryDlm	16
theta	16
vcov.Dlm	17
vcovTheta	17
Index	19

BayesDlm	<i>Bayesian Distributed Lag Model</i>
----------	---------------------------------------

Description

Parameters and summaries from a Bayesian DLM. Inherits from "[Dlm-class](#)".

Slots

- fitted fitted values; conditional expectation of observed y
- DIC Deviance Information Criterion
- residuals observed residuals
- sims list of posterior simulation draws of model parameters

References

Baek J, et al. (2016) Epidemiology 27(1):116-24. ([PubMed](#))

See Also

[dlm](#), [Dlm-class](#), [FreqDlm](#)

coef.Dlm	<i>Extract Distributed Lag Model Coefficients</i>
----------	---

Description

Return DLM coefficients

Usage

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

Details

Note that these are the basis-scaled coefficients. To extract coefficients on the scale of the original design (θ), see [theta](#).

Value

A numeric vector of fitted coefficients.

coef.sims	<i>Extract Coefficient Simulations</i>
-----------	--

Description

Extract simulated coefficients from a model fitted with MCMC

Usage

```
coef.sims(object, ...)
```

Arguments

object a fitted model object

Details

coef.sims is S4 generic.

Value

A numeric matrix

coef.sims, BayesDlm-method	<i>Extract Distributed Lag Coefficient Simulation Draws</i>
----------------------------	---

Description

Dlm objects fit by the Bayesian method store a matrix of simulated coefficients drawn via MCMC from their full conditional distribution. Extract the distributed lag-scaled simulated coefficient matrix.

Usage

```
## S4 method for signature 'BayesDlm'
coef.sims(object, ...)
```

Value

A numeric matrix containing the scaled simulated coefficient matrix

cr	<i>Cubic Radial Basis</i>
----	---------------------------

Description

Construct a natural cubic radial basis function for a given distance set vector and apply as a linear transformation of a covariate matrix.

Usage

```
cr(x, Z, ...)
```

Arguments

x	a vector of values to construct the basis from. Missing values are not allowed.
Z	a covariate matrix (or object that can be coerced to a matrix) to take the basis transformation of. <code>length(x)</code> should be the same as <code>ncol(Z)</code> . Missing values are not allowed.
...	arguments to be passed to lag.basis

Details

At the time of writing, `cr` is little more than a convenient wrapper to [lag.basis](#) intended to simplify the task of specifying lag terms in a model formula. The longer term goal is for `cr` (and potentially other basis functions) to replace `lag.basis` entirely.

Value

An S4 object of class [SmoothBasis](#).

dlm	<i>Distributed Lag Models</i>
-----	-------------------------------

Description

Fit distributed lag models to distance-profiled data. frequentist method relies on [lme](#). bayesian method uses Gibbs to sample from full conditionals, with sampling parameters named in the control list.

Usage

```
dlm(formula, data, subset, na.action, method = c("frequentist", "bayesian",
  "Frequentist", "Bayesian"), control = list(), ...)
```

Arguments

formula	an object of class " formula ": a symbolic description of the model to be fitted. See Details.
data	an optional data frame, list, or environment containing the variables of the fitted model.
subset	optional vector specifying a subset of observations to be used in the fitting process.
na.action	optional function that indicates what should happen when the data contains NA's.
method	method used to fit the DLM. Partial matching and capitalization allowed.
control	a list of simulation control parameters. See Details.
...	Ignored for now.

Details

Models are specified using familiar R formula syntax with one set of lag terms returned by a given smoothing function (e.g. see [cr](#)). The smoothing function can be any that returns a [SmoothLag](#) basis object. Multiple lag terms or interactions with lag terms are not allowed, nor are NA and missing-value lag terms supported. See Examples for a basic call to `d1m` using the formula interface, and a cubic radial lag basis specified via `cr`.

The control list specifies additional optional "bayes" method arguments, and may include: `n.sims`, the total number of simulations to run (default = 5000); `n.save`, the total number of simulations to save (default = 1000); `burnin`, number of simulations to discard from the start of the chain (default = 2000); `alpha.tau.prior`, prior (shape) parameter α_{τ^2} (default = 0.1); `beta.tau.prior`, prior (rate) parameter β_{τ^2} (default = 1e-6); `alpha.sigma.prior`, prior (shape) parameter α_{σ^2} (default = 0.1); `beta.sigma.prior`, prior (rate) parameter β_{σ^2} (default = 1e-6).

The prior distribution heirarchy we assume in the Bayesian formulation of the DLM is as follows:

$$\begin{aligned}
 y &\sim N(D\theta, \sigma^2 I_n) \\
 \theta &\sim N(\mu_\theta, \Sigma_\theta) \\
 \theta_l &\sim N(\mu_l, \tau^2) \\
 \sigma^2 &\sim Inv - Gamma(\alpha_{\sigma^2}, \frac{1}{\beta_{\sigma^2}}) \\
 \tau^2 &\sim Inv - Gamma(\alpha_{\tau^2}, \frac{1}{\beta_{\tau^2}})
 \end{aligned}$$

Where $l \in L$ indexes the set of lag coefficients.

Value

An S4 object that inherits from "[D1m](#)" containing the results of the fitted model. If construction of this object fails, `d1m` will issue a warning, and as a last resort attempt to return a list with components of the fitted model.

References

Baek J, et al. (2016) Epidemiology 27(1):116-24. ([PubMed](#))

See Also

[lme](#), [cr](#), [Dlm-class](#), [FreqDlm](#), [BayesDlm](#)

Examples

```
data (simdata)

## Setup distance count matrix and corresponding lag distances
X <- as.matrix(simdata[, -(1:3)])
lag <- seq(0.1, 10, length.out = ncol(X))

fit <- dlm(Y ~ Age + Gender + cr(lag, X), data = simdata)
summary (fit)
```

Dlm-class

S4 Distributed Lag Models

Description

Parent class for DLM object representation. Users will interact mainly with daughter classes, [FreqDlm](#) and [BayesDlm](#).

Slots

`method` character identifier for method (frequentist vs. Bayesian) used to fit the DLM
`call` language object containing matching function call
`coefficients` DLM coefficients
`sigma` residual standard deviation
`tau` random effects standard deviation
`logLik` log likelihood
`vcov` fitted variance-covariance matrix
`basis` [LagBasis](#) object containing lag basis representation
`N` Number of data points the model was fit to
`K` list of coefficient type lengths. See 'Details.'

See Also

[dlm](#), [LagBasis](#)

Examples

```
methods(class = "Dlm")
```

fitted.Dlm	<i>Extract DLM Model Fitted Values</i>
------------	--

Description

Extract the predicted y values from a fitted by `d1m`

Usage

```
## S3 method for class 'Dlm'  
fitted(object)
```

Arguments

object a fitted "`D1m`" object

Value

A numeric vector

fixef	<i>Extract Fixed Effects</i>
-------	------------------------------

Description

Returns a vector of fixed effects coefficients from a fitted mixed effects model.

Usage

```
fixef(object, ...)  
  
## S4 method for signature 'Dlm'  
fixef(object)
```

Details

fixef is S4 generic.

Value

A numeric vector

Methods (by class)

- D1m: S4 Method for "`D1m`" Objects

FreqDlm	<i>Classical Distributed Lag Model</i>
---------	--

Description

Parameters and summaries from a classically fit DLM (frequentist; model fit using [lme](#)). Inherits from "[Dlm-class](#)".

Slots

lme output of fitted lme object

References

Back J, et al. (2016) Epidemiology 27(1):116-24. ([PubMed](#))

See Also

[dlm](#), [lme](#), [Dlm-class](#), [BayesDlm](#)

lag.basis	<i>Cubic Radial Basis Functions for Distributed Lags</i>
-----------	--

Description

Compute cubic radial basis for a given lag set.

Usage

```
## S3 method for class 'basis'
lag(lag, center = TRUE, scale = FALSE)
```

Arguments

lag	Distributed lag to compute basis of
center	Either logical or numeric value to indicate if the lag should be mean centered before computing basis (center = TRUE), or else giving the value to center lag at.
scale	Either logical or numeric value to indicate if the lag should be standard deviation-scaled before computing basis (center = TRUE), or else giving the value to scale lag by.

Value

[LagBasis](#) object containing the basis matrix.

Examples

```
l <- seq(0.1, 10, length.out = 100)
lb <- lag.basis(l)
```


LagBasis

*Create and Manipulate Lag Basis Functions***Description**

S4 class object to store and query components of lag basis functions. User interface for creating this class can be found in [lag.basis](#).

Slots

x original lag data

x.center store the value the lag data was centered to. In theory this is useful for the non-yet-implemented predict method

x.scale store the value the lag data was scaled by. Again, should be useful primarily for the predict method in the future

C0 C_0 part of basis matrix

K1 K_1 part of basis matrix

References

Baek J, et al. (2016) Epidemiology 27(1):116-24. ([PubMed](#))

logLik.Dlm

*Extract Log-Likelihood***Description**

Log likelihood of the observed data given the model

Usage

```
## S3 method for class 'Dlm'
logLik(object, ...)
```

Value

An object of class "[logLik](#)" containing the log-likelihood of the data given the fitted DLM.

omega	<i>Extract Lag Basis Matrix</i>
-------	---------------------------------

Description

Extract lag basis matrix, Ω

Usage

```
omega(object, ...)
```

```
## S4 method for signature 'LagBasis'
```

```
omega(object, ...)
```

Details

omega is S4 generic.

Value

A square numeric matrix

Methods (by class)

- LagBasis: Method for "LagBasis" objects

plot.Dlm	<i>Plot a Fitted Dlm</i>
----------	--------------------------

Description

Plots point estimates and intervals for distributed lag terms from a fitted [dlm](#). Default aesthetic relies on [geom_pointrange](#) from the [ggplot2](#) package.

Usage

```
## S3 method for class 'Dlm'
```

```
plot(x, y, ...)
```

Arguments

x	a fitted " Dlm-class " object
...	additional arguments passed to summary.Dlm

Value

A [ggplot2](#) graphic object

predict.Dlm	<i>Generate New Predictions from a Fitted DLM</i>
-------------	---

Description

Not yet implemented

Usage

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

predict.LagBasis	<i>Predict New Values for Fitted Lag Basis</i>
------------------	--

Description

Not yet implemented

Usage

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

Arguments

object A [LagBasis](#) object

ranef	<i>Extract Random Effects</i>
-------	-------------------------------

Description

Returns a vector of random effects coefficients from a fitted mixed effects model.

Usage

```
ranef(object, ...)

## S4 method for signature 'Dlm'
ranef(object)
```

Details

ranef is S4 generic.

Value

A numeric vector

Methods (by class)

- Dlm: S4 Method for "Dlm" Objects

residuals.Dlm	<i>Extract DLM Model Residuals</i>
---------------	------------------------------------

Description

Extract residuals from a model fitted by `dlm`

Usage

```
## S3 method for class 'Dlm'
residuals(object)
```

Arguments

object a fitted "Dlm" object

Value

A numeric vector

scaleMat	<i>Extract Distributed Lag Scale Matrix</i>
----------	---

Description

Return lag coefficient scale matrix, S , such that the distributed lag coefficients fit by the model are obtained via the transformation $\beta = S\theta$. S should be invertable.

Usage

```
scaleMat(object, ...)

## S4 method for signature 'Dlm'
scaleMat(object, ...)
```

Arguments

object a fitted model object

Details

scaleMat is S4 generic.

Value

A square numeric matrix

Methods (by class)

- Dlm: S4 Method for "Dlm" Objects

`se.fixef`*Extract Standard Errors of Fixed Effects*

Description

Returns a vector of fixed effects standard errors from a fitted mixed effects model.

Usage

```
se.fixef(object)
```

```
## S4 method for signature 'Dlm'  
se.fixef(object)
```

Details

fixef is S4 generic.

Value

A numeric vector

Methods (by class)

- Dlm: S4 Method for "[Dlm](#)" Objects

`se.ranef`*Extract Standard Errors of Random Effects*

Description

Returns a vector of random effects standard errors from a fitted mixed effects model.

Usage

```
se.ranef(object)
```

```
## S4 method for signature 'Dlm'  
se.ranef(object)
```

Details

fixef is S4 generic.

Value

A numeric vector

Methods (by class)

- Dlm: S4 Method for "[Dlm](#)" Objects

sigma.Dlm

Extract Residual Standard Deviation 'Sigma'

Description

Return observed residual standard deviation

Usage

```
## S3 method for class 'Dlm'
sigma(object, ...)
```

Value

A positive numeric scalar: the residual standard deviation

simdata

Simulated Built Environment Data

Description

Simulated Built Environment Data

Usage

```
data(simdata)
```

Format

The first column (Y) is the outcome variable, covariates Gender and Age come next, and are followed by 100 location description variables. Each column of these 100 location count variables corresponds to a distance lag equal to the values in `seq(0.1, 10, 0.1)`.

References

Baek J, et al. (2016) Epidemiology 27(1):116-24. ([PubMed](#))

Examples

```
data(simdata)
simdata[1:10, 1:5]
```

SmoothLag

*Lag Matrix With Applied Smoothing***Description**

An S4 class object for representing a smoothed lag matrix in addition to containing details about the basis smoothing. Intended for use within `d1m` modeling framework to assist extraction of basis components treated as "fixed" and "random" effects. Inherits from `matrix`.

Slots

`basis` A `LagBasis` smoothing object containing details about the lag and the smoothing parameters used

`.Data` Contains the "fixed effects" components of the smoothed lag function. This scheme is intended to work conveniently with `stats::model.matrix`

`random` Contains the "random effects" components of the smoothed lag function

`signature` Character string containing the deparsed call to whatever smoothing function generated the `SmoothLag` object

`summary.D1m`*Summarize a Fitted D1m Object***Description**

Computes likelihood based statistics, t-statistic summaries, and correlations between fixed effects terms after the `nlme` package. Also computes rough distributional summaries for distributed lag terms (estimates and intervals, with confidence coefficient level determined by the `level` parameter).

Usage

```
## S3 method for class 'FreqD1m'
summary(object, level = 0.95, ...)
```

```
## S3 method for class 'BayesD1m'
summary(object, level = 0.95, ...)
```

Arguments

<code>object</code>	a fitted " <code>D1m</code> " object
<code>level</code>	desired confidence coefficient (or credible interval) level for summarizing distributed lag terms
<code>...</code>	ignored

Value

An S4 object of class "`SummaryD1m`"

SummaryDlm

*Summarize a Distributed Lag Model***Description**

Compute and store various statistical summaries of a fitted distributed lag model object

Slots

method Character vector with details of the model fitting procedure

call Matching call from dlm

coefficients Numeric vector of distributed lag coefficients

likelihood.stats Named numeric vector of likelihood based statistical summaries

variances Named numeric vector with estimated random effects and residual variance parameters

tTable t-statistic table summaries of fixed effects with (approximate) significance

lag.coefs A matrix with rough distributional summaries of the fitted lag coefficients, like estimates and confidence or posterior intervals.

cor.fixef Correlation matrix of fixed effects

residuals Numeric vector with the residuals from the fitted model

N Number of data points the model was fit to

K List of numbers of various covariate types

theta

*Extract Natural Scale Model Parameters 'Theta'***Description**

Extract θ coefficients from a fitted model

Usage

```
theta(object, ...)
```

```
## S4 method for signature 'Dlm'
theta(object, ...)
```

Arguments

object a fitted model object

Details

Returns the natural scale coefficients $\theta = S^{-1}\beta$ given some invertable scale matrix, S .
theta is S4 generic.

Value

A numeric vector

Methods (by class)

- Dlm: S4 Method for "Dlm" Objects

vcov.Dlm

Calculate the Distributed Lag Variance-Covariance Matrix for a Fitted Model Object

Description

Returns the variance-covariance matrix of the fitted model coefficients (including the random effects terms).

Usage

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

Value

A numeric matrix: the coefficient variance-covariance matrix

vcovTheta

Extract Natural Scale Coefficient Covariance Matrix

Description

Extract $var\theta$ matrix from a fitted model

Usage

```
vcovTheta(object, ...)

## S4 method for signature 'Dlm'
vcovTheta(object, ...)
```

Arguments

object a fitted model object

Details

Returns the covariance matrix for the natural scale coefficients, θ .
vcovTheta is S4 generic.

Value

A square numeric matrix

Methods (by class)

- D1m: S4 Method for "[D1m](#)" Objects

Index

*Topic **datasets**

- simdata, [14](#)
- .BayesDlm (BayesDlm), [2](#)
- .Dlm (Dlm-class), [6](#)
- .FreqDlm (FreqDlm), [8](#)
- .LagBasis (LagBasis), [9](#)
- .SmoothLag (SmoothLag), [15](#)
- .SummaryDlm (SummaryDlm), [16](#)
- BayesDlm, [2](#), [6](#), [8](#)
- coef.Dlm, [2](#)
- coef.sims, [3](#)
- coef.sims, BayesDlm-method, [3](#)
- cr, [4](#), [5](#), [6](#)
- Dlm, [5](#), [7](#), [12](#), [13](#), [15](#), [17](#), [18](#)
- dml, [2](#), [4](#), [6–8](#), [10](#), [12](#), [15](#)
- Dlm-class, [6](#)
- fitted.Dlm, [7](#)
- fixef, [7](#)
- fixef, Dlm-method (fixef), [7](#)
- formula, [5](#)
- FreqDlm, [2](#), [6](#), [8](#)
- geom_pointrange, [10](#)
- lag.basis, [4](#), [8](#), [9](#)
- LagBasis, [6](#), [8](#), [9](#), [11](#), [15](#)
- lme, [4](#), [6](#), [8](#)
- logLik, [9](#)
- logLik.Dlm, [9](#)
- omega, [10](#)
- omega, LagBasis-method (omega), [10](#)
- plot.Dlm, [10](#)
- predict.Dlm, [11](#)
- predict.LagBasis, [11](#)
- ranef, [11](#)
- ranef, Dlm-method (ranef), [11](#)
- residuals.Dlm, [12](#)
- scaleMat, [12](#)
- scaleMat, Dlm-method (scaleMat), [12](#)
- se.fixef, [13](#)
- se.fixef, Dlm-method (se.fixef), [13](#)
- se.ranef, [13](#)
- se.ranef, Dlm-method (se.ranef), [13](#)
- sigma.Dlm, [14](#)
- simdata, [14](#)
- SmoothBasis, [4](#)
- SmoothLag, [5](#), [15](#)
- summary.BayesDlm (summary.Dlm), [15](#)
- summary.Dlm, [10](#), [15](#)
- summary.FreqDlm (summary.Dlm), [15](#)
- SummaryDlm, [15](#), [16](#)
- theta, [3](#), [16](#)
- theta, Dlm-method (theta), [16](#)
- vcov.Dlm, [17](#)
- vcovTheta, [17](#)
- vcovTheta, Dlm-method (vcovTheta), [17](#)