

Package ‘bsreg’

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Type Package

Title Bayesian Spatial Regression Models

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Description Fit Bayesian models with a focus on the spatial econometric models.

Depends R (>= 3.5.0)

Imports R6, Matrix, stats, graphics, utils, grDevices

Suggests stochvol, coda

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bsreg-package	<i>Bayesian Spatial Regression Models</i>
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Description

Fit Bayesian models with a focus on the spatial econometric models.

bm	<i>Fit a Bayesian model</i>
----	-----------------------------

Description

Fit a Bayesian model

Usage

```

bm(x, ...)

## S3 method for class 'formula'
bm(
  x,
  data = NULL,
  n_save = 1000L,
  n_burn = 500L,
  options = set_options(),
  mh = set_mh(),
  verbose = TRUE,
  W,
  X_SLX,
  type = c("lm", "slx", "sar", "sem", "sdm", "sdem", "sv"),
  ...
)

## S3 method for class 'bm'
bm(x, n_save = 1000L, n_burn = 0L, verbose = TRUE, ...)

blm(...)

bslx(...)

bsar(...)

bsem(...)
```

```
bsdm(...)
```

```
bsdem(...)
```

```
bsv(...)
```

Arguments

<code>x</code>	Formula or <code>bm</code> object to sample with.
<code>...</code>	Not used.
<code>data</code>	A <code>data.frame</code> containing the variables in the model.
<code>n_save</code> , <code>n_burn</code>	Integer scalar. Number of draws for the burn-in period and to store for inference.
<code>options</code>	Settings for the prior setup. See set_options .
<code>mh</code>	Settings to tune the Metropolis-Hastings step. See set_mh .
<code>verbose</code>	Logical scalar. Whether to print status updates.
<code>W</code>	Numeric matrix (or function to construct one) with the spatial connectivities.
<code>X_SLX</code>	Numeric matrix with explanatory variables that should be lagged spatially.
<code>type</code>	Character scalar used to specify the desired model.

Value

Returns a list with draws from the specified Bayesian model and an object to obtain further samples.

Examples

```
N <- 100L
beta <- 1:5
X <- matrix(rnorm(N * 5), N, 5)
y <- X %*% beta + rnorm(N)

bm(y ~ X, n_burn = 100, n_draw = 100)

# Reproduce the linear model in Kuschnig (2022)
blm(log(sales) ~ log(price / cpi) + log(ndi / cpi) +
    factor(name) + factor(year), data = cigarettes)
```

cigarettes

Cigarette demand

Description

Panel dataset on cigarette demand in 46 US states from 1963 until 1992, see Baltagi and Levin (1992) and Baltagi and Li (2004). Extended with longitude and latitude from the `us_states` dataset.

Usage

cigarettes

Format

A `data.frame` object.

References

Baltagi, B. H. and Levin, D. (1992). Cigarette taxation: raising revenues and reducing consumption, *Structural Change and Economic Dynamics*, **3(2)**, 321-335. doi: [10.1016/0954349X\(92\)90010-4](https://doi.org/10.1016/0954349X(92)90010-4). Baltagi, B. H. and Li, D. (2004). Prediction in the panel data model with spatial correlation. *Advances in Spatial Econometrics*, 283-295. Springer, Berlin. doi: [10.1007/9783662056172_13](https://doi.org/10.1007/9783662056172_13).

coda

*Methods for **coda** Markov chain Monte Carlo objects*

Description

Methods to convert parameter and/or coefficient draws to **coda**'s `mcmc` format for further processing.

Usage

```
as.mcmc.bm(x, ...)
```

Arguments

<code>x</code>	A <code>bm</code> object, obtained from <code>bm</code> .
<code>...</code>	Other parameters for <code>as.mcmc</code> .

Value

Returns a **coda** `mcmc` object.

sample	<i>Obtain draws from a Bayesian model sampler</i>
--------	---

Description

Obtain draws from a Bayesian model sampler

Usage

```
sample(x, n_save = 1000L, n_burn = 0L, mh = set_mh(), verbose = TRUE)
```

Arguments

x	Bayesian model
n_save, n_burn	Integer scalar with number of draws to save / burn.
mh	Settings to tune the Metropolis-Hastings step. See set_mh .
verbose	Logical scalar. Whether to print status updates.

Value

Returns a numeric matrix with stored draws. The Bayesian model is modified in place.

set_mh	<i>Settings to tune a Metropolis-Hastings step</i>
--------	--

Description

Settings to tune a Metropolis-Hastings step

Usage

```
set_mh(adjust_burn = 0.8, acc_target = c(0.2, 0.45), acc_change = 0.01)
```

Arguments

adjust_burn	Numeric scalar with the percentage of burn-in that should be used to tune the MH step.
acc_target	Numeric vector with the lower and upper bound of the target acceptance rate for the MH step.
acc_change	Numeric scalar with the percentage adjustment to the proposal scale for tuning.

Value

Returns a list with settings to tune the Metropolis-Hastings step of a Bayesian model.

Examples

```
set_mh(0.5, c(0.1, 0.5), .05)
```

```
set_NG                                Set up a Normal-Gamma prior
```

Description

Set up a Normal-Gamma prior

Usage

```
set_NG(
  mu = 0,
  precision = 1e-08,
  shape = 0.01,
  rate = 0.01,
  beta = NULL,
  sigma = NULL
)
```

```
set_SNG(
  lambda_a = 0.01,
  lambda_b = 0.01,
  theta_scale = 0,
  theta_a = 1,
  lambda = 1,
  tau = 10,
  theta = 0.1
)
```

```
set_HS(lambda = 1, tau = 1, zeta = 1, nu = 1)
```

Arguments

mu	Numeric scalar or vector with the prior mean of 'beta'.
precision	Numeric scalar or matrix with the prior precision of 'beta'. Not used for shrinkage priors.
shape, rate	Numeric scalars with the prior shape and rate of 'sigma'.
lambda_a, lambda_b	Numeric scalars with the prior shape and rate of 'lambda'.
theta_scale	Numeric scalar with the proposal scale of 'theta'. Defaults to zero for a fixed value.
theta_a	Numeric scalar with the prior rate of 'theta'.
lambda, tau, theta, zeta, nu, beta, sigma	Numerics with starting values for the respective parameter.

Value

Returns a list with priors and settings.

set_options	<i>Set up Bayesian model priors and settings</i>
-------------	--

Description

Set up Bayesian model priors and settings

Usage

```
set_options(
  type = c("Independent", "Conjugate", "Shrinkage", "Horseshoe"),
  NG = set_NG(),
  SNG = set_SNG(),
  HS = set_HS(),
  SAR = set_SAR(),
  SLX = set_SLX(),
  SEM = set_SEM(),
  SV = set_SV(),
  ...
)
```

Arguments

type	Character scalar with the prior type for the nested linear model.
NG	Settings for the Normal-Gamma prior (independent or conjugate). See set_NG .
SNG	Settings for the Normal-Gamma shrinkage prior (Polson and Scott, 2010). See set_NG .
HS	Settings for the Horseshoe shrinkage prior (Makalic and Schmidt, 2015). See set_NG .
SAR	Settings for the spatial autoregressive setup. See set_SAR .
SLX	Settings for the spatially lagged explanatory setup. See set_SAR . Note that settings for the spatial term 'theta' are provided to <i>NG</i> instead.
SEM	Settings for the spatial error setup. See set_SAR .
SV	Settings for the stochastic volatility setup. See set_SV .
...	Used to provide custom prior elements.

Value

Returns a list with priors and settings for a Bayesian model.

Examples

```
set_options("Shrinkage", SNG = set_SNG(lambda_a = 1, lambda_b = 1))
```

set_SAR	<i>Set up a spatial prior</i>
---------	-------------------------------

Description

Set up a spatial prior

Usage

```
set_SAR(  
  lambda_a = 1.01,  
  lambda_b = 1.01,  
  lambda = 0,  
  lambda_scale = 0.1,  
  lambda_min = -1,  
  lambda_max = 1 - 1e-12,  
  delta_a = 1.01,  
  delta_b = 1.01,  
  delta = 1,  
  delta_scale = 0,  
  delta_min = 1e-12,  
  delta_max = Inf  
)
```

```
set_SLX(  
  lambda_a = 1.01,  
  lambda_b = 1.01,  
  lambda = 0,  
  lambda_scale = 0.1,  
  lambda_min = -1,  
  lambda_max = 1 - 1e-12,  
  delta_a = 1.01,  
  delta_b = 1.01,  
  delta = 1,  
  delta_scale = 0,  
  delta_min = 1e-12,  
  delta_max = Inf  
)
```

```
set_SEM(  
  lambda_a = 1.01,  
  lambda_b = 1.01,  
  lambda = 0,  
  lambda_scale = 0.1,  
  lambda_min = -1,  
  lambda_max = 1 - 1e-12,  
  delta_a = 1.01,
```



```

    delta_b = 1.01,
    delta = 1,
    delta_scale = 0,
    delta_min = 1e-12,
    delta_max = Inf
)

```

Arguments

lambda_a, lambda_b Numeric scalars with the prior shapes of the connectivity strength 'lambda'.

lambda, delta Numerics with starting values for the respective parameter.

lambda_scale Numeric scalar with the proposal scale of 'lambda'.

lambda_min, lambda_max Numeric scalars with upper and lower bounds for 'lambda'.

delta_a, delta_b Numeric scalars with the prior shapes of the connectivity parameter 'delta'.

delta_scale Numeric scalar with the proposal scale of 'delta'. Defaults to zero for a fixed value.

delta_min, delta_max Numeric scalars with upper and lower bounds for 'delta'.

Value

Returns a list with priors and settings.

set_SV	<i>Set up a volatility prior</i>
--------	----------------------------------

Description

Set up a volatility prior

Usage

```

set_SV(
  priors,
  mu = 0,
  phi = 0.5,
  sigma = 1,
  nu = Inf,
  rho = 0,
  beta = 0,
  latent0 = 0
)

```

Arguments

priors Prior settings from [specify_priors](#).
 mu, phi, sigma, nu, rho, beta, latent0
 Numerics with starting values for the respective parameter.

Value

Returns a list with priors and settings.

tune	<i>Burn-in and tune a Bayesian model sampler</i>
------	--

Description

Burn-in and tune a Bayesian model sampler

Usage

```
tune(x, n_burn = 1000L, mh = set_mh(), verbose = TRUE)
burn(x, n_burn = 1000L, verbose = TRUE)
```

Arguments

x Bayesian model
 n_burn Integer scalar with number of draws to save / burn.
 mh Settings to tune the Metropolis-Hastings step. See [set_mh](#).
 verbose Logical scalar. Whether to print status updates.

Value

Modifies the Bayesian model in place and returns it invisibly.

`us_states`*United States Historical States*

Description

Polygons of US state boundaries for the period 1960–2000. Subset from Siczewicz (2011). Licensed under CC BY-NC-SA 2.5 by the Atlas of Historical County Boundaries.

Usage`us_states`**Format**

A `data.frame` object.

Source

<https://publications.newberry.org/ahcbp/>

References

Siczewicz, P. (2011) U.S. Historical States and Territories (Generalized 0.01 deg). Dataset. Atlas of Historical County Boundaries, edited by Long, J. H. . Chicago: The Newberry Library, 2011. Available online from <https://publications.newberry.org/ahcbp/>.

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