

Package ‘dlbayes’

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Type Package

Title Use Dirichlet Laplace Prior to Solve Linear Regression Problem
and Do Variable Selection

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Description The Dirichlet Laplace shrinkage prior in Bayesian linear regression and variable selection, featuring:
utility functions in implementing Dirichlet-Laplace priors such as visualization;
scalability in Bayesian linear regression;
penalized credible regions for variable selection.

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dl *Implement the Dirichlet Laplace shrinkage prior in Bayesian linear regression*

Description

This function is the bayesian linear regression version of the algorithm proposed in Bhattacharya et al. (2015). The function is fast because we use fast sampling method compute posterior samples. The method proposed in Bhattacharya et al. (2015) is used in the second step perfectly solving the large p problem. The local shrinkage controlling parameter ψ_j are updated via a slice sampling scheme given by Polson et al. (2014). And the parameters ϕ_j have various inverse gaussian distribution. We generate variates with transformation into multiple roots by Michael et al. (1976).

Usage

```
dl(x, y, burn = 5000, nmc = 5000, thin = 1, hyper = 1/2)
```

Arguments

x	input matrix, each row is an observation vector, dimension $n \times p$.
y	Response variable, a $n \times 1$ vector.
burn	Number of burn-in MCMC samples. Default is 5000.
nmc	Number of posterior draws to be saved. Default is 5000.
thin	Thinning parameter of the chain. Default is 1 means no thinning.
hyper	The value of hyperparameter in the prior, can be $[1/\max(n,p), 1/2]$. It controls local shrinkage scales through ψ . Small values of hyperparameter would lead most of the result close to zero; while large values allow small singularity at zero. We give a method and a function to tuning this parameter. See the function called "dlhyper" for details.

Value

betamatrix	Posterior samples of beta. A large matrix $(nmc/thin) \times p$
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Examples

```
{
p=50
n=5
#generate x
x=matrix(rnorm(n*p),nrow=n)
#generate beta
beta=c(rep(0,10),runif(n=5,min=-1,max=1),rep(0,10),runif(n=5,min=-1,max=1),rep(0,p-30))
#generate y
y=x%%beta+rnorm(n)
hyper=dlhyper(x,y)
dlresult=dl(x,y,hyper=hyper)}
```

dlnalysis

dlnalysis

Description

This is a function that analyse the MCMC sampling result by computing the posterior mean, median and credible intervals

Usage

```
dlnalysis(dlresult, alpha = 0.05)
```

Arguments

dlresult	Posterior samples of beta. A large matrix (nmc/thin)*p
alpha	Level for the credible intervals. For example,the default is alpha = 0.05 means 95% credible intervals

Value

betamean	Posterior mean of beta, a p*1 vector.
LeftCI	The left bounds of the credible intervals.
RightCI	The right bounds of the credible intervals.
betamedian	Posterior median of Beta, a p*1 vector.

Examples

```
p=50
n=5
#generate x
x=matrix(rnorm(n*p),nrow=n)
#generate beta
beta=c(rep(0,10),runif(n=5,min=-1,max=1),rep(0,10),runif(n=5,min=-1,max=1),rep(0,p-30))
#generate y
y=x%%beta+rnorm(n)
hyper=dlhyper(x,y)
dlresult=dl(x,y,hyper=hyper)
da=dlnalysis(dlresult,alpha=0.05)
da$betamean
da$betamedian
da$LeftCI
da$RightCI
```

dlhyper

Tune the hyperparameter in the prior distribtuion

Description

This function is to tune the value of hyperparameter in the prior, which can be $[1/\max(n,p), 1/2]$. We use the method proposed by Zhang et al. (2018). This method tune the hyperparameter by incorporating a prior on R^2 . And they give a direct way to minimize KL directed divergence for special condition.

Usage

```
dlhyper(x, y)
```

Arguments

x	input matrix, each row is an observation vector, dimension $n \times p$. Same as the argument in dlmain
y	Response variable, a $n \times 1$ vector. Same as the argument in dlmain

Value

hyper	A value that can use in the following posterior computation
-------	---

Examples

```
p=50
n=6
#generate x
x=matrix(rnorm(n*p),nrow=n)
#generate beta
beta=c(rep(0,10),runif(n=5,min=-1,max=1),rep(0,10),runif(n=5,min=-1,max=1),rep(0,p-30))
#generate y
y=x*beta+rnorm(n)
hyper=dlhyper(x,y)
```

dlprior

Title Simulate the dirichlet laplace shrinkage prior

Description

This function generates random deviates from dirichlet laplace shrinkage prior and can plot the distribution function.

Usage

```
dlprior(hyper = 1/2, p = 1e+05, plt = TRUE, min = -5, max = 5,
        sigma = 1)
```

Arguments

hyper	important hyperparameter that related to posterior shrinkage scales and prior distribution
p	number of observations
plt	whether to plot the dirichlet laplace prior. default TRUE means plot the distribution
min	left point of the plot graph
max	right point of the plot graph
sigma	the value equals to normal noises' standard deviations

Value

beta	A $p \times 1$ vector. p observations from the distribution
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Examples

```
{theta=dlprior(hyper=1/2,p=100000,plt=TRUE,min=-5,max=5,sigma=1)}
```

dlvs

Title Do Bayesian variable selection via penalized credible region

Description

This is a function using the algorithm doing variable selection via penalized credible interval proposed by Bondell et al. (2012). The computation of the proposed sequence is doing matrix computing and using existing LASSO software.

Usage

```
dlvs(dlresult)
```

Arguments

dlresult	Posterior samples of beta. A large matrix $(nmc/thin) \times p$
----------	---

Value

betatil	Variable selection result of beta, a $p \times 1$ vector. Most of the values shrinks to 0
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Examples

```
{
p=30
n=5
#generate x
x=matrix(rnorm(n*p),nrow=n)
#generate beta
beta=c(rep(0,10),runif(n=5,min=-1,max=1),rep(0,10),runif(n=5,min=-1,max=1))
#generate y
y=x%%beta+rnorm(n)
hyper=dlhyper(x,y)
dlresult=dl(x,y,hyper=hyper)
dlvs(dlresult)
}
```

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