

Package ‘LINselect’

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Title Selection of Linear Estimators

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Description

Estimate the mean of a Gaussian vector, by choosing among a large collection of estimators, following the method developed by Y. Baraud, C. Giraud and S. Huet (2014) <[doi:10.1214/13-AIHP539](https://doi.org/10.1214/13-AIHP539)>.

In particular it solves the problem of variable selection by choosing the best predictor among predictors emanating from different methods as lasso, elastic-net, adaptive lasso, pls, randomForest. Moreover, it can be applied for choosing the tuning parameter in a Gauss-lasso procedure.

Imports mvtnorm, elasticnet, MASS, randomForest, pls, gtools, stats

Depends R (>= 3.5.0)

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penalty	<i>penalty</i>
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Description

Calculate the penalty function for estimators selection.

Usage

```
penalty(Delta, n, p, K)
```

Arguments

Delta	vector with $D_{\max}+1$ components : weights in the penalty function.
n	integer : number of observatons.
p	integer : number of variables.
K	scalar : constant in the penalty function.

Value

A vector with the same length as Delta: for each $d=0, \dots, D_{\max}$, let $N=n-d$, $D=d+1$ and $\text{pen}(d) = x K N/(N-1)$ where x satisfies

$\phi(x) = \exp(-\text{Delta}(d))$, when $\text{Delta}(d) < 50$,

where $\phi(x) = \text{pf}(q=x/(D+2), df1=D+2, df2=N-1, \text{lower.tail}=F) - (x/D) \text{pf}(q=(N+1)x/D(N-1), df1=D, df2=N+1, \text{lower.tail}=F)$

$\psi(x) = \text{Delta}(d)$, when $\text{Delta}(d) \geq 50$,

where $\psi(x) = \text{lbeta}(1+D/2, (N-1)/2) - \log(2(2x+(N-1)D)/((N-1)(N+2)x)) - (N-1)/2 \log((N-1)/(N-1+x)) - (D/2) \log(x)$

Note

The values of the penalty function greater than $1e+08$ are set to $1e+08$.

If for some $\text{Delta}(d)$ the equation $\phi(x) = \exp(-\text{Delta}(d)/(d+1))$ has no solution, then the execution is stopped.

Author(s)

Yannick Baraud, Christophe Giraud, Sylvie Huet

simulData

*simulData***Description**

Function to simulate data $Y = X\beta + \sigma N(0, 1)$

Usage

```
simulData(p = 100, n = 100, beta = NULL, C = NULL, r = 0.95,
          rSN = 10)
```

Arguments

p	integer : number of variates. Should be >15 if beta=NULL
n	integer : number of observations
beta	vector with p components. See details.
C	matrix p x p. Covariance matrix of X. See details.
r	scalar for calculating the covariance of X when C=NULL.
rSN	scalar : ratio signal/noise

Details

When beta is NULL, then p should be greater than 15 and beta=c(rep(2.5, 5), rep(1.5, 5), rep(0.5, 5), rep(0, p-15))

When C is NULL, then C is block diagonal with

$C[a, b] = r^{**abs(a-b)}$ for $1 \leq a, b \leq 15$

$C[a, b] = r^{**abs(a-b)}$ for $16 \leq a, b \leq p$

The lines of X are n i.i.d. gaussian variables with mean 0 and covariance matrix C.

The variance σ^{**2} equals the squared euclidean norm of $X\beta$ divided by $rSN*n$.

Value

A list with components :

Y	vector n : $Y = X\beta + \sigma N(0, 1)$
X	matrix n x p : values of the covariates. See details.
C	matrix p x p. See details
sigma	scalar. See details.
beta	vector with p components. See details.

Note

Library mvtnorm is loaded.

Author(s)

Yannick Baraud, Christophe Giraud, Sylvie Huet

tuneLasso

tuneLasso

Description

tune the lasso parameter in the regression model : $Y = X\beta + \sigma N(0, 1)$ using the lasso or the gauss-lasso method

Usage

```
tuneLasso(Y, X, normalize = TRUE, method = c("lasso", "Glasso"),
          dmax = NULL, Vfold = TRUE, V = 10, LINselect = TRUE, a = 0.5,
          K = 1.1, verbose = TRUE, max.steps = NULL)
```

Arguments

Y	vector with n components : response variable.
X	matrix with n rows and p columns : covariates.
normalize	logical : corresponds to the input normalize of the functions enet and cv.enet . If TRUE the variates X are normalized.
method	vector of characters whose components are subset of ("lasso", "Glasso")
dmax	integer : maximum number of variables in the lasso estimator. $dmax \leq D$ where $D = \min(3*p/4, n-5)$ if $p \geq n$ $D = \min(p, n-5)$ if $p < n$. Default : $dmax = D$.
Vfold	logical : if TRUE the tuning is done by Vfold-CV
V	integer. Gives the value of V in the Vfold-CV procedure
LINselect	logical : if TRUE the tuning is done by LINselect
a	scalar : value of the parameter α in the LINselect criteria
K	scalar : value of the parameter K in the LINselect criteria
verbose	logical : if TRUE a trace of the current process is displayed in real time.
max.steps	integer : maximum number of steps in the lasso procedure. Corresponds to the input max.steps of the function enet . Default : $max.steps = 2*\min(p, n)$

Value

A list with one or two components according to method.

lasso if method contains "lasso" is a list with one or two components according to Vfold and LINselect.

- Ls if LINselect=TRUE. A list with components
 - support: vector of integers. Estimated support of the parameter vector β .
 - coef: vector whose first component is the estimated intercept.
The other components are the estimated non zero coefficients.
 - fitted: vector with length n. Fitted value of the response.
 - crit: vector containing the values of the criteria for each value of lambda.
 - lambda: vector containing the values of the tuning parameter of the lasso algorithm.
- CV if Vfold=TRUE. A list with components
 - support: vector of integers. Estimated support of the parameter vector β .
 - coef: vector whose first component is the estimated intercept.
The other components are the estimated non zero coefficients.
 - fitted: vector with length n. Fitted value of the response.
 - crit: vector containing the values of the criteria for each value of lambda.
 - crit.err: vector containing the estimated standard-error of the criteria.
 - lambda: vector containing the values of the tuning parameter of the lasso algorithm.

Glasso if method contains "Glasso". The same as lasso.

Note

library elasticnet is loaded.

Author(s)

Yannick Baraud, Christophe Giraud, Sylvie Huet

References

See Baraud et al. 2010 <http://hal.archives-ouvertes.fr/hal-00502156/fr/>
Giraud et al., 2013, <https://projecteuclid.org/DPubS?service=UI&version=1.0&verb=Display&handle=euclid.ss/1356098553>

Examples

```
#source("charge.R")
library("LINselect")

# simulate data with
## Not run: ex <- simulData(p=100,n=100,r=0.8,rSN=5)

## Not run: ex1.tuneLasso <- tuneLasso(ex$Y,ex$X)

## Not run: data(diabetes)
```

```
## Not run: attach(diabetes)
## Not run: ex.diab <- tuneLasso(y,x2)
## Not run: detach(diabetes)
```

VARselect

VARselect

Description

Estimation in the regression model : $Y = X\beta + \sigma N(0,1)$
 Variable selection by choosing the best predictor among predictors emanating from different methods as lasso, elastic-net, adaptive lasso, pls, randomForest.

Usage

```
VARselect(Y, X, dmax = NULL, normalize = TRUE, method = c("lasso",
  "ridge", "pls", "en", "ALridge", "ALpls", "rF", "exhaustive"),
  pen.crit = NULL, lasso.dmax = NULL, ridge.dmax = NULL, pls.dmax = NULL,
  en.dmax = NULL, ALridge.dmax = NULL, ALpls.dmax = NULL, rF.dmax = NULL,
  exhaustive.maxdim = 5e+05, exhaustive.dmax = NULL, en.lambda = c(0.01,
    0.1, 0.5, 1, 2, 5), ridge.lambda = c(0.01, 0.1, 0.5,
    1, 2, 5), rF.lmtry = 2, pls.ncomp = 5, ALridge.lambda = c(0.01,
    0.1, 0.5, 1, 2, 5), ALpls.ncomp = 5, max.steps = NULL,
  K = 1.1, verbose = TRUE, long.output = FALSE)
```

Arguments

Y	vector with n components : response variable.
X	matrix with n rows and p columns : covariates.
dmax	integer : maximum number of variables in the lasso estimator. $dmax \leq D$ where $D = \min(3*p/4, n-5)$ if $p \geq n$ $D = \min(p, n-5)$ if $p < n$. Default : $dmax = D$.
normalize	logical : if TRUE the columns of X are scaled
method	vector of characters whose components are subset of "lasso", "ridge", "pls", "en", "ALridge", "ALpls", "rF", "exhaustive".
pen.crit	vector with $dmax+1$ components : for $d=0, \dots, dmax$, $penalty[d+1]$ gives the value of the penalty for the dimension d. Default : $penalty = NULL$. In that case, the penalty will be calculated by the function <code>penalty</code> .
lasso.dmax	integer lower than dmax, default = dmax.
ridge.dmax	integer lower than dmax, default = dmax.
pls.dmax	integer lower than dmax, default = dmax.
en.dmax	integer lower than dmax, default = dmax.

ALridge.dmax	integer lower than dmax, default = dmax.
ALpls.dmax	integer lower than dmax, default = dmax.
rF.dmax	integer lower than dmax, default = dmax.
exhaustive.maxdim	integer : maximum number of subsets of covariates considered in the exhaustive method. See details.
exhaustive.dmax	integer lower than dmax, default = dmax
en.lambda	vector : tuning parameter of the ridge. It is the input parameter lambda of function enet
ridge.lambda	vector : tuning parameter of the ridge. It is the input parameter lambda of function <code>lmridge:lm.ridge</code>
rF.lmtry	vector : tuning parameter mtry of function randomForest , mtry =p/rF.lmtry.
pls.ncomp	integer : tuning parameter of the pls. It is the input parameter ncomp of the function pls . See details.
ALridge.lambda	similar to ridge.lambda in the adaptive lasso procedure.
ALpls.ncomp	similar to pls.ncomp in the adaptive lasso procedure. See details.
max.steps	integer. Maximum number of steps in the lasso procedure. Corresponds to the input max.steps of the function enet . Default : max.steps = 2*min(p,n)
K	scalar : value of the parameter K in the LINselect criteria.
verbose	logical : if TRUE a trace of the current process is displayed in real time.
long.output	logical : if FALSE only the component summary will be returned. See Value.

Details

When method is pls or ALpls, the LINselect procedure is carried out considering the number of components in the pls method as the tuning parameter. This tuning parameter varies from 1 to pls.ncomp.

When method is exhaustive, the maximum number of variate d is calculated as follows. Let q be the largest integer such that $\text{choose}(p,q) < \text{exhaustive.maxdim}$. Then $d = \min(q, \text{exhaustive.dmax}, \text{dmax})$.

Value

A list with at least `length(method)` components.
For each procedure in `method` a list with components

- `support`: vector of integers. Estimated support of the parameters β for the considered procedure.
- `crit`: scalar equals to the LINselect criteria calculated in the estimated support.
- `fitted`: vector with length n . Fitted value of the response calculated when the support of β equals support.

- `coef`: vector whose first component is the estimated intercept. The other components are the estimated non zero coefficients when the support of β equals support.

If `length(method) > 1`, the additional component summary is a list with three components:

- `support`: vector of integers. Estimated support of the parameters β corresponding to the minimum of the criteria among all procedures.
- `crit`: scalar. Minimum value of the criteria among all procedures.
- `method`: vector of characters. Names of the procedures for which the minimum is reached

If `pen.crit = NULL`, the component `pen.crit` gives the values of the penalty calculated by the function `penalty`. If `long.output` is `TRUE` the component named `chaty` is a list with `length(method)` components.

For each procedure in `method`, a list with components

- `support` where `support[[1]]` is a vector of integers containing an estimator of the support of the parameters β .
- `crit`: vector where `crit[1]` contains the value of the LINselect criteria calculated in `support[[1]]`.

Note

When `method` is `lasso`, library `elasticnet` is loaded.

When `method` is `en`, library `elasticnet` is loaded.

When `method` is `ridge`, library `MASS` is loaded.

When `method` is `rF`, library `randomForest` is loaded.

When `method` is `pls`, library `pls` is loaded.

When `method` is `ALridge`, libraries `MASS` and `elasticnet` are loaded.

When `method` is `ALpls`, libraries `pls` and `elasticnet` are loaded.

When `method` is `exhaustive`, library `gtools` is loaded.

Author(s)

Yannick Baraud, Christophe Giraud, Sylvie Huet

References

See Baraud et al. 2010 <http://hal.archives-ouvertes.fr/hal-00502156/fr/>
 Giraud et al., 2013, <https://projecteuclid.org/DPubS?service=UI&version=1.0&verb=Display&handle=euclid.ss/1356098553>

Examples

```
#source("charge.R")
library("LINselect")

# simulate data with
# beta=c(rep(2.5,5),rep(1.5,5),rep(0.5,5),rep(0,p-15))
```

```
ex <- simulData(p=100,n=100,r=0.8,rSN=5)

## Not run: ex1.VARselect <- VARselect(ex$Y,ex$X,exhaustive.dmax=2)

## Not run: data(diabetes)
## Not run: attach(diabetes)
## Not run: ex.diab <- VARselect(y,x2,exhaustive.dmax=5)
## Not run: detach(diabetes)
```

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