Package ‘ADMMnet’

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Type Package

Title Regularized Model with Selecting the Number of Non-Zeros

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Description Fit linear and cox models regularized with net (L1 and Laplacian), elastic-net (L1 and L2) or lasso (L1) penalty, and their adaptive forms, such as adaptive lasso and net adjusting for signs of linked coefficients. In addition, it treats the number of non-zero coefficients as another tuning parameter and simultaneously selects with the regularization parameter. The package uses one-step coordinate descent algorithm and runs extremely fast by taking into account the sparsity structure of coefficients.

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Description

This package fits linear and cox models regularized with net (L1 and Laplacian), elastic-net (L1 and L2) or lasso (L1) penalty, and their adaptive forms, such as adaptive lasso and net adjusting for signs of linked coefficients. In addition, it treats the number of non-zero coefficients as another tuning parameter and simultaneously selects with the regularization parameter $\lambda$. This is motivated by formulating L0 variable selection in ADMM form. By selecting the regularization parameter and the number of non-zeros, it shows significant improvement over the commonly used regularized methods, which depend on the regularization parameter only.

The package uses one-step coordinate descent algorithm and runs extremely fast by taking into account the sparsity structure of coefficients.

Details

Package: ADMMnet
Type: Package
Version: 0.1
Date: 2015-12-10
License: GPL (>= 2)

Functions: ADMMnet, print.ADMMnet

Author(s)

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References

http://dl.acm.org/citation.cfm?id=2185816

http://www.jstatsoft.org/v33/i01/

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3423227/

Examples

### Linear model ###

```r
set.seed(1213)
N=100; p=30; p1=5
x=matrix(rnorm(N*p),N,p)
beta=rnorm(p1)
xb=x[,1:p1]
y=rnorm(N,xb)

fiti=ADMMnet(x,y,penalty="Lasso",nlambda=10,nfolds=10) # Lasso
# attributes(fiti)
```

### Cox model ###

```r
set.seed(1213)
N=100; p=30; p1=5
x=matrix(rnorm(N*p),N,p)
beta=rnorm(p1)
xb=x[,1:p1]
ty=rexp(N,exp(xb))
tcens=rbinom(n=N,prob=.3,size=1) # censoring indicator
y=cbind(time=ty,status=1-tcens)

fiti=ADMMnet(x,y,family="cox",penalty="Lasso",nlambda=10,nfolds=10) # Lasso
# attributes(fiti)
```

---

**ADMMnet**

*Fit a Model with Various Regularization Forms*

**Description**

Fit a linear or cox model regularized with net (L1 and Laplacian), elastic-net (L1 and L2) or lasso (L1) penalty, and their adaptive forms, such as adaptive lasso and net adjusting for signs of linked coefficients. In addition, it treats the number of non-zero coefficients as another tuning parameter and simultaneously selects with the regularization parameter lambda. The package uses one-step coordinate descent algorithm and runs extremely fast by taking into account the sparsity structure of coefficients.

**Usage**

```r
ADMMnet(x, y, family = c("gaussian", "cox"), penalty = c("Lasso", "Enet", "Net"),
Omega = NULL, alpha = 1.0, lambda = NULL, nlambda = 50, rlambda = NULL,
folds = 1, foldid = NULL, inzero = TRUE, adaptive = c(FALSE, TRUE), aini = NULL,
isd = FALSE, keep.beta = FALSE, ifast = TRUE, thresh = 1e-07, maxit = 1e+05)
```
Arguments

- **x**: input matrix. Each row is an observation vector.

- **y**: response variable. For `family = "gaussian"`, y is a continuous vector. For `family = "cox"`, y is a two-column matrix with columns named 'time' and 'status'. 'status' is a binary variable, with '1' indicating event, and '0' indicating right censored.

- **family**: type of outcome. Can be "gaussian" or "cox".

- **penalty**: penalty type. Can choose "Net", "Enet" (elastic net) and "Lasso". For "Net", need to specify Omega; otherwise, "Enet" is performed. For `penalty = "Net"`, the penalty is defined as
  \[ \lambda \alpha \| \beta \|_1 + (1 - \alpha)/2 \cdot (\beta^T L \beta), \]
  where \( L \) is a Laplacian matrix calculated from Omega.

- **Omega**: correlation/adjacency matrix with zero diagonal, used for `penalty = "Net"` to calculate Laplacian matrix.

- **alpha**: ratio between L1 and Laplacian for "Net", or between L1 and L2 for "Enet". Default is \( \alpha = 1.0 \), i.e. lasso.

- **lambda**: a user supplied decreasing sequence. If `lambda = NULL`, a sequence of lambda is generated based on `nlambda` and `rlambda`. Supplying a value of `lambda` overrides this.

- **nlambda**: number of lambda values. Default is 50.

- **rlambda**: fraction of lambda.max to determine the smallest value for lambda. The default is \( rlambda = 0.0001 \) when the number of observations is larger than or equal to the number of variables; otherwise, \( rlambda = 0.01 \).

- **nfolds**: number of folds. With `nfolds = 1` and `foldid = NULL` by default, cross-validation is not performed. For cross-validation, smallest value allowable is `nfolds = 3`. Specifying `foldid` overrides `nfolds`.

- **foldid**: an optional vector of values between 1 and `nfolds` specifying which fold each observation is in.

- **inzero**: logical flag for simultaneously selecting the number of non-zero coefficients with lambda. Default is `inzero = TRUE`.

- **adaptive**: logical flags for adaptive version. Default is `adaptive = c(FALSE,TRUE)`. The first element is for adaptive on \( \beta \) in L1 and the second for adjusting for signs of linked coefficients in Laplacian matrix.

- **aini**: a user supplied initial estimate of \( \beta \). It is a list including `wbeta` for adaptive L1 and `sgn` for adjusting Laplacian matrix. `wbeta` is the absolute value of inverse initial estimates. If `aini = NULL` but adaptive is required, `aini` is generated from regularized model with `penalty = "Enet"` and `alpha = 0.0`, i.e. a ridge regression.

- **isd**: logical flag for outputing standardized coefficients. \( x \) is always standardized prior to fitting the model. Default is `isd = FALSE`, returning \( \beta \) on the original scale.
keep.beta  logical flag for returning estimates for all lambda values. For keep.beta = FALSE, only return the estimate with the minimum cross-validation value.

ifast  logical flag for efficient calculation of risk set updates for family = "cox". Default is ifast = TRUE.

thresh  convergence threshold for coordinate descent. Default value is 1E-7.

maxit  Maximum number of iterations for coordinate descent. Default is 10^5.

Details

One-step coordinate descent algorithm is applied for each lambda. For family = "cox", ifast = TRUE adopts an efficient way to update risk set and sometimes the algorithm ends before all nlambda values of lambda have been evaluated. To evaluate small values of lambda, use ifast = FALSE. The two methods only affect the efficiency of algorithm, not the estimates.

x is always standardized prior to fitting the model and the estimate is returned on the original scale. For family = "gaussian", y is centered by removing its mean, so there is no intercept output.

Cross-validation is used for tuning parameters. For inzero = TRUE, we further select the number of non-zero coefficients obtained from regularized model at each lambda. This is motivated by formulating L0 variable selection in ADMM form, which shows significant improvement over the commonly used regularized methods without this technique.

Value

An object with S3 class "ADMMnet".

- Beta: a sparse Matrix of coefficients, stored in class "dgCMatrix".
- Beta0: coefficients after additionally tuning the number of non-zeros, for inzero = TRUE.
- fit: a data.frame containing lambda and the number of non-zero coefficients nzero. With cross-validation, additional results are reported, such as average cross-validation partial likelihood cvm and its standard error cvse, and index with '*' indicating the minimum cvm. For family = "gaussian", rsq is also reported.
- fit0: a data.frame containing lambda, cvm and nzero based on inzero = TRUE.
- lambda.min: value of lambda that gives minimum cvm.
- lambda.opt: value of lambda based on inzero = TRUE.
- penalty: penalty type.
- adaptive: logical flags for adaptive version (see above).
- flag: convergence flag (for internal debugging). flag = 0 means converged.

Warning

It may terminate and return NULL.

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References

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See Also

print.ADMMnet

Examples

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fiti=ADMMnet(x,y,penalty="Lasso",nlambda=10,nfolds=10) # Lasso
# attributes(fiti)
```

### Cox model ###

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set.seed(1213)
N=100; p=30; p1=5
x=matrix(rnorm(N*p),N,p)
beta=rnorm(p1)
xb=x[,1:p1]
ty=rexp(N,exp(xb))
tcens=rbinom(n=N,prob=.3,size=1) # censoring indicator
y=cbind(time=ty,status=1-tcens)
fiti=ADMMnet(x,y,family="cox",penalty="Lasso",nlambda=10,nfolds=10) # Lasso
# attributes(fiti)
```
print.ADMMnet

Print a ADMMnet Object

Description

Print a summary of results along the path of lambda.

Usage

## S3 method for class 'ADMMnet'
print(x, digits = 4, ...)

Arguments

x  
fitted ADMMnet object
digits  
significant digits in printout
...
  
additional print arguments

Details

The performed model is printed, followed by fit and fit0 (if any) from a fitted ADMMnet object.

Value

The data frame above is silently returned

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See Also

ADMMnet

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beta=rnorm(p1)
xb=x[,1:p1]
y=rnorm(N,xb)

fiti=ADMMnet(x,y,penalty="Lasso",nlambda=10,nfolds=10) # Lasso

fiti
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