Package 'scio'

February 20, 2015

Title Sparse Column-wise Inverse Operator

Version 0.6.1

Author Xi (Rossi) LUO and Weidong Liu

Maintainer Xi (Rossi) LUO <xi.rossi.luo@gmail.com>

Suggests clime, lorec, QUIC

Description Sparse Column-wise Inverse Operator for estimating the inverse covariance matrix. Note that this is a preliminary version accompanying the arXiv paper (arXiv:1203.3896) in 2012. This version contains only the minimal set of functions for estimation and cross validation.

License GPL-2

NeedsCompilation yes

Repository CRAN

Date/Publication 2014-04-15 18:42:18

R topics documented:

`scio` *Sparse Column-wise Inverse Operator*

Description

Estimates a sparse inverse covariance matrix using Sparse Column-wise Inverse Operator

Usage

```
scio(S, lambda,  thr=1e-4, maxit=1e4, pen.diag=F, sym=T)
```

Arguments

S	Input covariance matrix of size p by p (symmetric).
lambda	(Non-negative) regularization parameter for the lasso penalty. Can be a scalar or a matrix of size p by p.
thr	Threshold for convergence. Iterations stop when the maximum change in two successive updates is less than thr. Default value is 1e-4.
maxit	Maximum number of iterations for each column computation. Default 10,000.
pen.diag	Whether the diagonal should be penalized. Default False.
sym	Whether the return values should be symmetrized. Default True.

Details

This is a fast, nonparametric approach to estimate sparse inverse covariance matrices, with possibly really large dimensions. Details of this procedure are described in the reference.

Value

A list with components:

w	Estimated inverse covariance matrix

References

Weidong Liu and Xi Luo (2012). Fast and Adaptive Sparse Precision Matrix Estimation in High Dimensions. arXiv:1203.3896.

Examples

```
set.seed(100)
x<-matrix(rnorm(50*20),ncol=4)
s<- var(x)
a<-scio(s, lambda=.01)
```

---

scio.cv *Sparse Column-wise Inverse Operator*

Description

Cross validated estimates of a sparse inverse covariance matrix using Sparse Column-wise Inverse Operator

Usage

```
scio.cv(X, lambda.max=1, alpha=0.95, cv.maxit=1e2, ...)
```

Arguments

X	Input data of dimension samples (n) x variables (p).
lambda.max	Maximum lambda to start with in CV, which is decreased by mutliplying alpha in each iteration.
alpha	Scaling factor to decrease lambda by multiplication.
cv.maxit	Maximum number of CV iterations. Default 1e2.
...	Other option parameters in scio.

Details

This is a fast, nonparametric approach to estimate sparse inverse covariance matrices, with possibly really large dimensions. Details of this procedure are described in the reference.

This function does a simple cross validation based on likelihood.

Value

A list with components:

w	Estimated inverse covariance matrix
lambda.cv	CV selected lambda

References

Weidong Liu and Xi Luo (2012). Fast and Adaptive Sparse Precision Matrix Estimation in High Dimensions. arXiv:1203.3896.

Examples

```
set.seed(100)
x<-matrix(rnorm(50*20),ncol=4)
a<-scio.cv(x)
```

---

scio.refit *Refitted Sparse Column-wise Inverse Operator*

Description

Refitted SCIO Estimators using Penalized Likelihood

Usage

```
scio.refit(S, Omega,thr=1e-4, ...)
```

Arguments

S	Input covariance matrix of size p by p (symmetric).
Omega	Estimated inverse covariance matrices. Can be a matrix of size p by p from scio or a collection of matrices from sciopath.
thr	Tolerance. Small entries in magnitude (<thr) in Omega are treated as zeros when refitting the precision matrix with the same support as the scio or sciopath outputs. Default 1e-4.
...	Additional options passed on to QUIC, which is the only likelihood solver called in the current release. More solvers will be included in future releases.

Details

This implements the refitting procedure discussed in Cai, Liu, and Luo (2011). The current version uses the QUIC solver for the penalized likelihood criterion. More solvers will be added.

Value

A list with one component:

w	Estimated inverse covariance matrix when a single Omega matrix is supplied, or an array of matrices when a 3 dimensional array of Omega is supplied.

References

Weidong Liu and Xi Luo (2012). Fast and Adaptive Sparse Precision Matrix Estimation in High Dimensions. arXiv:1203.3896.

Tony Cai, Weidong Liu, and Xi Luo (2011). A Constrained L1 Minimization Approach to Sparse Precision Matrix Estimation. Journal of the American Statistical Association, 106(494), 594-607.

Examples

```
set.seed(100)
x<-matrix(rnorm(50*20),ncol=4)
s<- var(x)
a<-scio(s, lambda=.01)

require(QUIC)
b <- scio.refit(s, a$w)
```

---

sciopath *Compute the SCIO estimates for a grid of penalty values*

Description

Estimates a sparse inverse covariance matrix using a Sparse Column-wise Inverse Operator, path-following a grid of values for the regularization parameter

Usage

```
sciopath(S, lambdalist=NULL, thr = 1e-4, maxit = 1e4, pen.diag=F, sym=T)
```

Arguments

S	Input covariance matrix of size p by p (symmetric).
lambdalist	Vector of non-negative regularization parameters for the lasso penalty. The path is computed from the largest to the smallest value of this vector. If not given, 10 values are generated.
thr	Threshold for convergence. Iterations stop when the maximum change in two successive updates is less than thr. Default 1e-4.
maxit	Maximum number of iterations for each column computation. Default 10,000.
pen.diag	Whether the diagonal should be penalized. Default False.
sym	Whether the return values should be symmetrized. Default True.

Details

This is a fast, nonparametric approach to estimate sparse inverse covariance matrices, with possibly really large dimensions. Details of this procedure are described in the reference.

Value

A list with components:

wlist	Estimated covariance matrices, an array of dimension (nrow(s),ncol(n), length(lambdalist))
lambdalist	Regularization parameters used

References

Weidong Liu and Xi Luo (2012). Fast and Adaptive Sparse Precision Matrix Estimation in High Dimensions. arXiv:1203.3896.

Examples

```
set.seed(100)
x <- matrix(rnorm(50*20),ncol=4)
s <- var(x)
a <- sciopath(s)
```

Index