

Package ‘clrdag’

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Type Package

Title Constrained Likelihood Ratio Tests for a Directed Acyclic Graph

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Depends R (>= 3.5.0)

Imports Rcpp (>= 1.0.1)

LinkingTo Rcpp, RcppArmadillo

Description The 'clrdag' package provides an R function 'MLEdag' for constrained maximum likelihood estimation and likelihood ratio test of a large directed acyclic graph. Documentations about 'clrdag' is provided by the vignette included in this package and via the paper by Li, Shen, and Pan (2019).

License GPL (>= 2)

URL <https://github.com/chunlinli/clrdag>

BugReports <https://github.com/chunlinli/clrdag/issues>

NeedsCompilation yes

R topics documented:

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Description

A function computes the MLE/LRT of a Gaussian directed acyclic graph using difference convex programming and alternating direction method of multipliers.

Usage

```
MLEdag(X, A = NULL, Lambda = NULL, D = NULL, tau, mu, rho,
       tol_abs = 1e-04, tol_rel = 1e-04,
       dc_max_iter = 20, admm_max_iter = 1000, trace_obj = TRUE)
```

Arguments

| | |
|----------------------------|--|
| X | An n by p data matrix, where n is the number of observations and p is the dimension. |
| A, Lambda | Initial estimate. A is a p by p adjacency matrix, Lambda is a p by p dual matrix in acyclicity condition. A must be a DAG! If A is NULL (default), the initial estimate is provided automatically (Be careful!). |
| D | A p by p matrix indicating hypothesized edges. For the entries equal to one, no sparse penalty is imposed. If D is not provided, or if all off-diagonal entries of D are zero, no test is performed. |
| tau | A positive real number. tau is the threshold parameter in TLP. |
| mu | A positive real number. mu is the sparsity parameter. |
| rho | A positive real number. rho is the ADMM dual parameter. |
| tol_abs, tol_rel | Positive real. The absolute and relative tolerance. |
| dc_max_iter, admm_max_iter | Positive integer. The maximum iteration number of DC and ADMM. |
| trace_obj | Logical. If TRUE, the objective values are printed after each iteration. |

Value

The function returns a LIST containing the following components.

| | |
|------------|--|
| X | The input data matrix. |
| A | The final estimate of adjacency matrix. Returned if no test is performed. |
| A.H1, A.H0 | The final estimates of adjacency matrix under alternative and null. Returned if a test is performed. |
| Lambda | The final estimate of dual variables in the acyclicity condition. Returned if no test is performed. |

| | |
|-----------|--|
| Lambda.H1 | The final estimate of dual variables in the acyclicity condition under alternative. Returned if a test is performed. |
| D | A matrix indicating hypothesized edges. Returned if a test is performed. |
| tau | The input threshold parameter in TLP. |
| mu | The input sparsity parameter. |
| lrt | $(2 \times \log\text{-likelihood ratio})$ of alternative over null. Returned if a test is performed. |
| df | Degrees of freedom of the test. Returned if a test is performed. |
| pval | The p -value of the test. Returned if a test is performed. |

Author(s)

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References

Li, C., Shen, X., and Pan, W. (2019). Likelihood ratio tests for a large directed acyclic graph. *Journal of the American Statistical Association*. Accepted.

Examples

```
##
## Example: random graph
##
library(clrdag)
set.seed(2019)
p<-10
n<-1000
## random graph: randomly generate adjacency matrix A, A lower triangular
sparsity <- 2/p
A <- matrix(rbinom(p*p,1,sparsity)*sign(runif(p*p,min=-1,max=1)),p,p)
A[upper.tri(A,diag=TRUE)] <- 0
X <- matrix(rnorm(n*p),n,p)
out <- MLEdag(X=X,tau=0.3,mu=1,rho=1.2,trace_obj=FALSE) # compute the MLE
sum(abs((out$A!=0)-(A!=0))) # Hamming distance to the truth graph

# test edge 1 --> 2
D <- matrix(0,p,p)
D[2,1] <- 1
out <- MLEdag(X=X,D=D,tau=0.3,mu=1,rho=1.2,trace_obj=FALSE) # compute the MLE
out$pval
```

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