Package 'amanpg'

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Title Alternating Manifold Proximal Gradient Method for Sparse PCA

Type Package

Description Alternating Manifold Proximal Gradient Method for Sparse PCA uses the Alternating Manifold Proximal
Gradient (AManPG) method to find sparse principal components from a data or covariance matrix. Provides
a novel algorithm for solving the sparse principal component analysis problem which provides advantages over existing methods in terms of efficiency and convergence guarantees.
Chen, S., Ma, S., Xue, L., & Zou, H. (2020) <doi:10.1287/ijoo.2019.0032>.
Zou, H., Hastie, T., & Tibshirani, R. (2006) <doi:10.1198/106186006X113430>.
Zou, H., & Xue, L. (2018) <doi:10.1109/JPROC.2018.2846588>.

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VignetteBuilder knitr

Suggests knitr, rmarkdown

Encoding UTF-8

NeedsCompilation no

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Depends R (>= 3.5.0)

Repository CRAN

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Contents

`normalize` *Matrix Normalization*

Description

Center the input matrix to mean 0 and scale to Euclidean length 1

Usage

```
normalize(x, center=TRUE, scale=TRUE)
```

Arguments

`x`	matrix to be normalized
`center`	centers the input matrix to mean 0 if TRUE, default if TRUE
`scale`	scales the input matrix to Euclidean length 1 if TRUE, default is TRUE

Value

`x`	normalized matrix

Author(s)

Shixiang Chen, Justin Huang, Benjamin Jochem, Shiqian Ma, Lingzhou Xue and Hui Zou

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`prox.l1` *Proximal L1 Mapping*

Description

Calculates the proximal L1 mapping for the given input matrix

Usage

```
prox.l1(z, lambda, r)
```

Arguments

z	input matrix
lambda	parameters for calculating proximal L1 mapping
r	number of columns used in matrix

Value

x_prox	proximal L1 Mapping

Author(s)

Shixiang Chen, Justin Huang, Benjamin Jochem, Shiqian Ma, Lingzhou Xue and Hui Zou

References

Chen, S., Ma, S., Xue, L., and Zou, H. (2020) "An Alternating Manifold Proximal Gradient Method for Sparse Principal Component Analysis and Sparse Canonical Correlation Analysis" *INFORMS Journal on Optimization* 2:3, 192-208

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spca.amanpg *Alternating Manifold Proximal Gradient algorithm for Sparse PCA*

Description

Performs sparse principal component analysis on the input matrix using an alternating manifold proximal gradient (AManPG) method

Usage

```
spca.amanpg(z, lambda1, lambda2, f_palm = 1e5, x0 = NULL, y0 = NULL, k = 0, type = 0,
      gamma = 0.5, maxiter = 1e4, tol = 1e-5, normalize = TRUE, verbose = FALSE)
```

Arguments

z	Either the data matrix or sample covariance matrix
lambda1	List of parameters of length n for L1-norm penalty
lambda2	L2-norm penalty term
f_palm	Upper bound for the gradient value to reach convergence, default value is 1e5
x0	Initial x-values for the gradient method, default value is the first n right singular vectors
y0	Initial y-values for the gradient method, default value is the first n right singular vectors
k	Number of principal components desired, default is 0 (returns min(n-1, p) principal components)

type	If 0, b is expected to be a data matrix, and otherwise b is expected to be a covariance matrix; default is 0
gamma	Parameter to control how quickly the step size changes in each iteration, default is 0.5
maxiter	Maximum number of iterations allowed in the gradient method, default is 1e4
tol	Tolerance value required to indicate convergence (calculated as difference between iteration f-values), default is 1e-5
normalize	Center and normalize rows to Euclidean length 1 if True, default is True
verbose	Function prints progress between iterations if True, default is False

Value

iter	total number of iterations executed in the algorithm
f_amanpg	final gradient value
sparsity	Number of sparse loadings (loadings == 0) divided by number of all loadings
time	execution time in seconds
x	corresponding matrix in subproblem to the loadings
loadings	loadings of the sparse principal components

Author(s)

Shixiang Chen, Justin Huang, Benjamin Jochem, Shiqian Ma, Lingzhou Xue and Hui Zou

References

Chen, S., Ma, S., Xue, L., and Zou, H. (2020) "An Alternating Manifold Proximal Gradient Method for Sparse Principal Component Analysis and Sparse Canonical Correlation Analysis" *INFORMS Journal on Optimization* 2:3, 192-208

Examples

```
#see SPCA.R for a more in-depth example
      d <- 500  # dimension
      m <- 1000 # sample size
      a <- normalize(matrix(rnorm(m * d), m, d))
      lambda1 <- 0.1 * matrix(data=1, nrow=4, ncol=1)
      x0 <- svd(a, nv=4)$v
     sprout <- spca.amanpg(a, lambda1, lambda2=Inf, f_palm=1e5, x0=x0, y0=x0, k=4, type=0,
                     gamma=0.5, maxiter=1e4, tol=1e-5, normalize = FALSE, verbose=FALSE)
     print(paste(sprout$iter, "iterations,", sprout$sparsity, "sparsity,", sprout$time))

      #extract loadings
      #print(sprout$loadings)
```

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