Package ‘amanpg’

October 6, 2021

Version 0.3.3

Date 2021-10-04

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.


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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

Date/Publication 2021-10-05 23:20:34 UTC
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**normalize**

*Matrix Normalization*

**Description**

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

**Usage**

```r
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**

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

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


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

```r
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)
spca.amanpg

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 be-
tween 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

```r
#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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