Package 'rolleigen'

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Type Package

Title Rolling Eigenanalysis

Version 1.0.1

Description Fast and efficient computation of rolling and expanding eigenanalysis for time-series data. The 'rolleigen' package decomposes the covariance matrix of the explanatory variables into eigenvalues and eigenvectors to perform principal component analysis (Pearson, 1901, <doi:10.1080/14786440109462720>; Hotelling, 1933, <doi:10.1037/h0071325>) and principal component regression (Massy, 1965, <doi:10.1080/01621459.1965.10480787>) over rolling and expanding windows. For each window, the eigenvalues and eigenvectors are computed from the covariance matrix and, optionally, ordered from the largest to smallest eigenvalue to summarize the directions of greatest variation in the data. A subset of leading components is then used to fit a regression that mitigates collinearity in the explanatory variables. Use cases include dimensionality reduction, factor extraction, and regression on collinear explanatory variables. The package supports rolling and expanding windows, weights, and handling of missing values via the min_obs, complete_obs, and na_restore arguments. The implementation uses the online and offline algorithms from the 'roll' package to compute rolling and expanding cross-products efficiently, with parallelism across columns and windows provided by 'RcppParallel'.

License GPL (>= 2)

URL https://github.com/jasonjfoster/rolleigen

BugReports https://github.com/jasonjfoster/rolleigen/issues

Depends R (>= 3.5.0)

Imports Rcpp, RcppParallel

Suggests covr, pls, roll, testthat, zoo

LinkingTo Rcpp, RcppArmadillo, RcppParallel, roll (>= 1.1.7)

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`rolleigen-package` *Rolling Eigenanalysis*

Description

Fast and efficient computation of rolling and expanding eigenanalysis for time-series data. The 'rolleigen' package decomposes the covariance matrix of the explanatory variables into eigenvalues and eigenvectors to perform principal component analysis (Pearson, 1901, <doi:10.1080/14786440109462720>; Hotelling, 1933, <doi:10.1037/h0071325>) and principal component regression (Massy, 1965, <doi:10.1080/01621459.1965. over rolling and expanding windows. For each window, the eigenvalues and eigenvectors are computed from the covariance matrix and, optionally, ordered from the largest to smallest eigenvalue to summarize the directions of greatest variation in the data. A subset of leading components is then used to fit a regression that mitigates collinearity in the explanatory variables. Use cases include dimensionality reduction, factor extraction, and regression on collinear explanatory variables. The package supports rolling and expanding windows, weights, and handling of missing values via the min_obs, complete_obs, and na_restore arguments. The implementation uses the online and offline algorithms from the 'roll' package to compute rolling and expanding cross-products efficiently, with parallelism across columns and windows provided by 'RcppParallel'.

Details

`rolleigen` is a package that provides fast and efficient computation of rolling and expanding eigenanalysis for time-series data.

Author(s)

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References

Hotelling, H. (1933). "Analysis of a Complex of Statistical Variables Into Principal Components." *Journal of Educational Psychology*, 24(6), 417-441. doi:10.1037/h0071325

Massy, W.F. (1965). "Principal Components Regression in Exploratory Statistical Research." *Journal of the American Statistical Association*, 60(309), 234-256. doi:10.1080/01621459.1965.10480787

Pearson, K. (1901). "On Lines and Planes of Closest Fit to Systems of Points in Space." *Philosophical Magazine*, 2(11), 559-572. doi:10.1080/14786440109462720

`roll_eigen` *Rolling Eigenvalues and Eigenvectors*

Description

A function for computing the rolling and expanding eigenvalues and eigenvectors of time-series data.

Usage

```
roll_eigen(x, width, weights = rep(1, width), center = TRUE,
  scale = FALSE, order = TRUE, min_obs = width, complete_obs = TRUE,
  na_restore = FALSE, online = TRUE)
```

Arguments

`x`	vector or matrix. Rows are observations and columns are variables.
`width`	integer. Window size.
`weights`	vector. Weights for each observation within a window.
`center`	logical. If `TRUE` then the weighted mean of each variable is used, if `FALSE` then zero is used.
`scale`	logical. If `TRUE` then the weighted standard deviation of each variable is used, if `FALSE` then no scaling is done.
`order`	logical. Change sign and order of the components.
`min_obs`	integer. Minimum number of observations required to have a value within a window, otherwise result is `NA`.
`complete_obs`	logical. If `TRUE` then rows containing any missing values are removed, if `FALSE` then pairwise is used.
`na_restore`	logical. Should missing values be restored?
`online`	logical. Process observations using an online algorithm.

Value

A list containing the following components:

`values`	An object of the same class and dimension as `x` with the rolling and expanding eigenvalues.
`vectors`	A cube with each slice the rolling and expanding eigenvectors.

Examples

```
n <- 15
m <- 3
x <- matrix(rnorm(n * m), nrow = n, ncol = m)
weights <- 0.9 ^ (n:1)

# rolling eigenvalues and eigenvectors with complete windows
roll_eigen(x, width = 5)

# rolling eigenvalues and eigenvectors with partial windows
roll_eigen(x, width = 5, min_obs = 1)

# expanding eigenvalues and eigenvectors with partial windows
roll_eigen(x, width = n, min_obs = 1)

# expanding eigenvalues and eigenvectors with partial windows and weights
roll_eigen(x, width = n, min_obs = 1, weights = weights)
```

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roll_pcr *Rolling Principal Component Regressions*

Description

A function for computing the rolling and expanding principal component regressions of time-series data.

Usage

```
roll_pcr(x, y, width, n_comps = ncol(x), weights = rep(1, width),
  intercept = TRUE, center = TRUE, scale = FALSE, min_obs = width,
  complete_obs = TRUE, na_restore = FALSE, online = TRUE)
```

Arguments

x	vector or matrix. Rows are observations and columns are the independent variables.
y	vector or matrix. Rows are observations and columns are the dependent variables.
width	integer. Window size.
n_comps	integer. Number of principal components.
weights	vector. Weights for each observation within a window.
intercept	logical. Either TRUE to include or FALSE to remove the intercept.
center	logical. If TRUE then the weighted mean of each variable is used, if FALSE then zero is used.
scale	logical. If TRUE then the weighted standard deviation of each variable is used, if FALSE then no scaling is done.

min_obs	integer. Minimum number of observations required to have a value within a window, otherwise result is NA.
complete_obs	logical. If TRUE then rows containing any missing values are removed, if FALSE then pairwise is used.
na_restore	logical. Should missing values be restored?
online	logical. Process observations using an online algorithm.

Value

A list containing the following components:

coefficients	A list of objects with the rolling and expanding coefficients for each y. An object is the same class and dimension (with an added column for the intercept) as x.
r.squared	A list of objects with the rolling and expanding r-squareds for each y. An object is the same class as x.

Examples

```
n <- 15
m <- 3
x <- matrix(rnorm(n * m), nrow = n, ncol = m)
y <- rnorm(n)
weights <- 0.9 ^ (n:1)

# rolling regressions with complete windows
roll_pcr(x, y, width = 5, n_comps = 1)

# rolling regressions with partial windows
roll_pcr(x, y, width = 5, n_comps = 1, min_obs = 1)

# expanding regressions with partial windows
roll_pcr(x, y, width = n, n_comps = 1, min_obs = 1)

# expanding regressions with partial windows and weights
roll_pcr(x, y, width = n, n_comps = 1, min_obs = 1, weights = weights)
```

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