Package 'RSO'

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Title Ridge Selection Operator for Sparse Linear Regression

Version 1.0.0

Description Implements the Ridge Selection Operator (RSO)
for variable selection in linear regression as proposed by
Wu (2021) <doi:10.1080/00401706.2020.1791254>.
The RSO method extends classical ridge regression by using individually
penalized ridge parameters, inducing sparsity through reciprocal penalty parameters.
This package provides a fast C++ implementation ('RSOFast')
using 'Armadillo' linear algebra routines.
The fast implementation precomputes matrix products, uses Cholesky
factorization with primal/dual switching, and performs golden-section
search for coordinate optimization.

License GPL (>= 3)

Encoding UTF-8

RoxygenNote 7.3.2

LinkingTo Rcpp, RcppArmadillo

Imports Rcpp

NeedsCompilation yes

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Repository CRAN

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ridgereg *Individually Penalized Ridge Regression*

Description

Computes the sum of squared residuals (SSR) for individually penalized ridge regression without explicitly forming the hat matrix. Uses Cholesky decomposition for speed and numerical stability.

Usage

```
ridgereg(x, y, gam, penalty.factor = rep(1, length(gam)))
```

Arguments

x	Centered predictor matrix (n x p)
y	Centered response vector (n x 1)
gam	Ridge penalty parameters vector (p x 1) where gam_j = 1/nu_j
penalty.factor	Adaptive penalty factors (p x 1), default = 1 for RSO

Value

Sum of squared residuals (SSR)

Examples

```
n <- 100; p <- 10
x <- matrix(rnorm(n*p), n, p)
x <- scale(x, scale = FALSE)
y <- rnorm(n)
y <- y - mean(y)
gam <- runif(p)
result <- ridgereg(x, y, gam, rep(1, p))
```

ridgeRegPrecomp *Individually Penalized Ridge Regression with Precomputed Matrices*

Description

Computes the sum of squared residuals (SSR) for individually penalized ridge regression using precomputed X'X and X'y matrices. This is optimized for repeated calls with the same x matrix but different gam parameters (e.g., during grid search).

Usage

```
ridgeRegPrecomp(x, y, gam, penalty.factor = rep(1, length(gam)), precomp)
```

Arguments

x	Centered predictor matrix (n x p)
y	Centered response vector (n x 1)
gam	Ridge penalty parameters vector (p x 1) where gam_j = 1/nu_j
penalty.factor	Adaptive penalty factors (p x 1), default = 1 for RSO
precomp	List containing precomputed values: • xtx: X'X matrix (p x p) • xty: X'y vector (p x 1)

Value

Sum of squared residuals (SSR)

Examples

```
n <- 100; p <- 10
x <- matrix(rnorm(n*p), n, p)
x <- scale(x, scale = FALSE)
y <- rnorm(n)
y <- y - mean(y)
precomp <- list(xtx = crossprod(x), xty = crossprod(x,y))
gam <- runif(p)
result <- ridgeRegPrecomp(x, y, gam, rep(1, p), precomp)
```

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ridgereg_df *Ridge Regression with Degrees of Freedom*

Description

Computes the sum of squared residuals (SSR), degrees of freedom (trace of hat matrix), and coefficient estimates for ridge regression. Uses Cholesky decomposition for speed and numerical stability.

Usage

```
ridgereg_df(x, y, gam, penalty.factor = rep(1, length(gam)))
```

Arguments

x	Centered predictor matrix (n x p)
y	Centered response vector (n x 1)
gam	Ridge penalty parameters vector (p x 1) where gam_j = 1/nu_j
penalty.factor	Adaptive penalty factors (p x 1), default = 1 for RSO

Value

A list containing:

ssr	Sum of squared residuals
df	Degrees of freedom (trace of hat matrix)
coef	Coefficient estimates (p x 1)

Examples

```
n <- 100; p <- 10
x <- matrix(rnorm(n*p), n, p)
x <- scale(x, scale = FALSE)
y <- rnorm(n)
y <- y - mean(y)
gam <- runif(p)
result <- ridgereg_df(x, y, gam, rep(1, p))
```

RSOFast *Fast RSO (Ridge Selection Operator)*

Description

Implements the modified coordinate descent algorithm for RSO as described in Wu (2021). Solves for optimal lambda parameters that minimize SSR subject to sum(lambda) = tau and lambda >= 0.

Usage

```
RSOFast(x, y, tau, penalty.factor = rep(1, ncol(x)), gaminit = NULL)
```

Arguments

x	Centered predictor matrix (n x p)
y	Centered response vector (n x 1)
tau	Regularization parameter (sum of lambda)
penalty.factor	Adaptive penalty factors (p x 1), default = 1 for RSO
gaminit	Initial lambda values. If NULL, uses tau/p for all.

Value

A list containing:

gamma	Optimal lambda vector (p x 1)
lambda	Alias for gamma
coefficients	Coefficient estimates (p x 1)
coef	Alias for coefficients

df	Degrees of freedom
ssr	Sum of squared residuals
iterations	Number of iterations
converged	Convergence status
n_selected	Number of selected variables
tau	Original tau parameter

References

Wu, Y. (2021). Can't ridge regression perform variable selection?. Technometrics, 63(2), 263-271. doi:10.1080/00401706.2020.1791254

Examples

```
n <- 100; p <- 10
x <- matrix(rnorm(n*p), n, p)
x <- scale(x, scale = FALSE)
y <- rnorm(n)
y <- y - mean(y)
result <- RSOFast(x, y, tau = 1.0, rep(1, p))
```

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