

Package ‘cols’

March 24, 2026

Type Package

Title Constrained Ordinary Least Squares

Version 1.6

Date 2026-03-24

Author Michail Tsagris [aut, cre]

Maintainer Michail Tsagris <mtsagris@uoc.gr>

Depends R (>= 4.0)

Imports nnsolve, quadprog, Rfast, Rfast2

Description Constrained ordinary least squares is performed. One constraint is that all beta coefficients (including the constant) cannot be negative. They can be either 0 or strictly positive. Another constraint is that the sum of the beta coefficients equals a constant. References: Hansen, B. E. (2022). Econometrics, Princeton University Press. <ISBN:9780691235899>.

License GPL (>= 2)

NeedsCompilation no

Repository CRAN

Date/Publication 2026-03-24 14:00:02 UTC

Contents

cols-package	2
Constrained least squares	2
Lower and upper bound constrained least squares	4
Positive and unit sum constrained least squares	5
Positively constrained least squares	6
Positively constrained least squares with a multivariate response	7
Index	8

cols-package

Constrained Ordinary Least Squares

Description

Constrained ordinary least squares is performed. One constraint is that all beta coefficients (including the constant) cannot be negative. They can be either 0 or strictly positive. Another constraint is that the sum of the beta coefficients equals a constant. References: Hansen, B.E. (2022). Econometrics, Princeton University Press.

Details

Package: cols
Type: Package
Version: 1.6
Date: 2026-03-24

Maintainers

Michail Tsagris <mtsagris@uoc.gr>.

Author(s)

Michail Tsagris <mtsagris@uoc.gr>

References

Hansen, B. E. (2022). Econometrics, Princeton University Press.

Constrained least squares

Constrained least squares

Description

Constrained least squares.

Usage

```
cls(y, x, R, ca)
mvcls(y, x, R, ca)
```

Arguments

y	The response variable. For the <code>cls()</code> a numerical vector with observations, but for the <code>mvcls()</code> a numerical matrix .
x	A matrix with independent variables, the design matrix.
R	The R vector that contains the values that will multiply the beta coefficients. See details and examples.
ca	The value of the constraint, $R^T\beta = c$. See details and examples.

Details

This is described in Chapter 8.2 of Hansen (2019). The idea is to minimise the sum of squares of the residuals under the constraint $R^T\beta = c$. As mentioned above, be careful with the input you give in the x matrix and the R vector. The `cls()` function performs a single regression model, whereas the `mcls()` function performs a regression for each column of y. Each regression is independent of the others.

Value

A list including:

be	A numerical matrix with the constrained beta coefficients.
mse	A numerical vector with the mean squared error.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Hansen, B. E. (2022). *Econometrics*, Princeton University Press.

See Also

[pls](#), [int.cls](#)

Examples

```
x <- as.matrix( iris[1:50, 1:4] )
y <- rnorm(50)
R <- c(1, 1, 1, 1)
cls(y, x, R, 1)
```

Lower and upper bound constrained least squares
Constrained least squares

Description

Lower and upper bound constrained least squares

Usage

```
int.cls(y, x, lb, ub)
int.mcls(y, x, lb, ub)
```

Arguments

y	The response variable. For the int.cls() a numerical vector with observations, but for the int.mcls() a numerical matrix .
x	A matrix with independent variables, the design matrix.
lb	A vector or a single value with the lower bound(s) in the coefficients.
ub	A vector or a single value with the upper bound(s) in the coefficients.

Details

This function performs least squares under the constraint that the beta coefficients lie within interval(s), i.e. $\min \sum_{i=1}^n (y_i - \mathbf{x}_i^T \boldsymbol{\beta})^2$ such that $lb_j \leq \beta_j \leq ub_j$.

Value

A list including:

be	A numerical matrix with the constrained beta coefficients.
mse	A numerical vector with the mean squared error.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

See Also

[pls](#)

Examples

```
x <- as.matrix( iris[1:50, 1:4] )
y <- rnorm(50)
int.cls(y, x, -0.2, 0.2)
```

Positive and unit sum constrained least squares

Positive and unit sum constrained least squares

Description

Positive and unit sum constrained least squares.

Usage

```
pcls(y, x)
mpcls(y, x)
```

Arguments

y	The response variable. For the pcls() a numerical vector with observations, but for the mpcls() a numerical matrix.
x	A matrix with independent variables, the design matrix.

Details

The constraint is that all beta coefficients are positive and sum to 1. that is $\min \sum_{i=1}^n (y_i - \mathbf{x}_i \top \boldsymbol{\beta})^2$ such that $0 \leq \beta_j \leq 1$ and $\sum_{j=1}^d \beta_j = 1$. The pcls() function performs a single regression model, whereas the mpcls() function performs a regression for each column of y. Each regression is independent of the others.

Value

A list including:

be	A numerical matrix with the positively constrained beta coefficients.
mse	A numerical vector with the mean squared error.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

See Also

[pls](#), [cls](#), [mvpls](#)

Examples

```
x <- as.matrix( iris[1:50, 1:4] )
y <- abs( rnorm(50) )
pcls(y, x)
```

 Positively constrained least squares

Positively constrained least squares

Description

Positively constrained least squares.

Usage

```
pls(y, x)
mpls(y, x)
```

Arguments

y	The response variable. For the pls() a numerical vector with observations, but for the mpls() a numerical matrix .
x	A matrix with independent variables, the design matrix.

Details

The constraint is that all beta coefficients (including the constant) are non negative, i.e. $\min \sum_{i=1}^n (y_i - \alpha_i^T \beta)^2$ such that $\beta_j \geq 0$. The pls() function performs a single regression model, whereas the mpls() function performs a regression for each column of y. Each regression is independent of the others.

Value

A list including:

be	A numerical matrix with the positively constrained beta coefficients.
mse	A numerical vector with the mean squared error(s).

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

See Also

[cls](#), [pcls](#), [mvpls](#)

Examples

```
x <- as.matrix( iris[1:50, 1:4] )
y <- abs( rnorm(50) )
pls(y, x)
```

Positively constrained least squares with a multivariate response

Positively constrained least squares with a multivariate response

Description

Positively constrained least squares with a multivariate response.

Usage

```
mvpls(y, x)
```

Arguments

`y` The response variables, a numerical matrix with observations.
`x` A matrix with independent variables, the design matrix.

Details

The constraint is that all beta coefficients (including the constant) are positive, i.e. $\min \sum_{i=1}^n (\mathbf{y}_i - \mathbf{x}_i \boldsymbol{\beta})^\top (\mathbf{y}_i - \mathbf{x}_i \boldsymbol{\beta})$ such that $\beta_{jk} \geq 0$.

Value

A list including:

`be` The positively constrained beta coefficients.
`mse` The mean squared error.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

See Also

[cls](#)

Examples

```
y <- as.matrix( iris[, 1:2] )  
x <- as.matrix( iris[, 3:4] )  
mvpls(y, x)
```

Index

cls, [5–7](#)
cls (Constrained least squares), [2](#)
cols-package, [2](#)
Constrained least squares, [2](#)

int.cls, [3](#)
int.cls (Lower and upper bound
constrained least squares), [4](#)
int.mcls (Lower and upper bound
constrained least squares), [4](#)

Lower and upper bound constrained
least squares, [4](#)

mpcls (Positive and unit sum
constrained least squares), [5](#)
mpls (Positively constrained least
squares), [6](#)
mvcls (Constrained least squares), [2](#)
mvpls, [5](#), [6](#)
mvpls (Positively constrained least
squares with a multivariate
response), [7](#)

pcls, [6](#)
pcls (Positive and unit sum
constrained least squares), [5](#)
pls, [3–5](#)
pls (Positively constrained least
squares), [6](#)
Positive and unit sum constrained
least squares, [5](#)
Positively constrained least squares, [6](#)
Positively constrained least squares
with a multivariate response, [7](#)