

# Package ‘cols’

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**Type** Package

**Title** Constrained Ordinary Least Squares

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**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)

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cols-package

*Constrained Ordinary Least Squares*

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### 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

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### Maintainers

Michail Tsagris <mtsagris@uoc.gr>.

### Author(s)

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### References

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

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Constrained least squares

*Constrained least squares*

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### 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)
```

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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.  $\min \sum_{i=1}^n (y_i - \mathbf{x}_i^T \boldsymbol{\beta})^2$  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)
```

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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)
```

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