

# Package ‘SEPaLS’

July 21, 2025

**Title** Shrinkage for Extreme Partial Least-Squares (SEPaLS)

**Date** 2023-10-11

**Type** Package

**Version** 0.1.0

**Description** Regression context for the Partial Least Squares framework for Extreme values. Estimations of the Shrinkage for Extreme Partial Least-Squares (SEPaLS) estimators, an adaptation of the original Partial Least Squares (PLS) method tailored to the extreme-value framework.

The SEPaLS project is a joint work by Stephane Girard, Hadrien Lorenzo and Julyan Arbel.

R code to replicate the results of the paper is available at

<[https://github.com/hlorenzo/SEPaLS\\_simus](https://github.com/hlorenzo/SEPaLS_simus)>.

Extremes within PLS was already studied by one of the authors, see M

Bousebeta, G Enjolras, S Girard (2023) <[doi:10.1016/j.jmva.2022.105101](https://doi.org/10.1016/j.jmva.2022.105101)>.

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bootstrap.SEPaLS      *Bootstrap function for SEPaLS estimator.*

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### Description

Bootstrap function for SEPaLS estimator.

### Usage

```
bootstrap.SEPaLS(
  X,
  Y,
  yn,
  type = c("vMF", "Laplace"),
  mu0 = NULL,
  kappa0 = NULL,
  lambda = NULL,
  B = 20
)
```

### Arguments

X	$(n \times p)$ -dimensional matrix of the covariates.
Y	$(n)$ -dimensional vector of the response.
yn	$y_n$ the quantile corresponding to lowest values of Ys to put in the tail.
type	character, whether vMF for von Mises-Fisher prior or Laplace for Laplace prior. See details.
mu0	$\mu_0$ , unitary $(p)$ -dimensional vector. The direction parameter for the vMF prior.
kappa0	$\kappa_0$ , positive. The concentration parameter for the vMF prior.
lambda	$\lambda$ , positive. The concentration parameter for the Laplace prior.
B	positive integer. The number of bootstrap samples on which estimate the SEPaLS directions. Default to 20.

### Value

A list with two elements:

- ws: A  $(B \times p)$ -dimensional matrix with each row corresponding to the *SEPaLS* direction estimated on each bootstrap sample.
- cor: The correlation of each estimate direction on the Out-Of-Bag (OOB) sample with the response.

### See Also

[SEPaLS](#)

**Examples**

```

set.seed(5)
n <- 3000
p <- 10
X <- matrix(rnorm(n*p),n,p)
beta <- c(5:1,rep(0,p-5)) ; beta <- beta/sqrt(sum(beta^2))
Y <- (X%*%beta)^3 + rnorm(n)
boot.sepals_Laplace <- bootstrap.SEPaLS(X,Y,yn=1,type="Laplace",lambda=0.01,
B=100)
boxplot(boot.sepals_Laplace$ws);abline(h=0,col="red",lty=2)

```

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```

maximum_Likelihood_SEPaLS

```

*Maximum Likelihood estimator*

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**Description**

Maximum Likelihood estimator

**Usage**

```

maximum_Likelihood_SEPaLS(X, Y, yn)

```

**Arguments**

X                     $(n \times p)$ -dimensional matrix of the covariates.  
Y                     $(n)$ -dimensional vector of the response.  
yn                    the quantile corresponding to the lowest values of Y's to put in the tail.

**Value**

The maximum likelihood estimator.

**Examples**

```

n <- 3000
p <- 10
X <- matrix(rnorm(n*p),n,p)
beta <- c(5:1,rep(0,p-5)) ; beta <- beta/sqrt(sum(beta^2))
Y <- X%*%beta + rnorm(n,sd=1/3)
estimators <- do.call(rbind,lapply(seq(0,1,length.out=100),function(pp){
  yn <- quantile(Y,probs = pp)
  maximum_Likelihood_SEPaLS(X,Y,yn)
}))
matplot(estimators,type="l",lty=1,col=c(rep(2,5),rep(1,p-5)))
abline(h=beta/sqrt(sum(beta^2)),col=c(rep(2,5),rep(1,p-5)))

```

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ricaCarrots	<i>The RICA dataset describing the production of carrots (open field) (in quintals) from 2000 to 2015.</i>
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### Description

A subset of data from the ‘agreste’ French governmental website <<https://agreste.agriculture.gouv.fr/agreste-web/servicon/I.2/listeTypeServicon/>>.

### Usage

```
data(ricaCarrots)
```

### Format

‘ricaCarrots’

A List of 3 objects:

**Y** a vector. The production of carrots (open field) (in quintals) for 598 French farms.

**X** a matrix. The 259 covariates describing the same 598 French farms.

**description** a matrix. Description of the 259 covariates.

### Source

<<https://agreste.agriculture.gouv.fr/agreste-web/servicon/I.2/listeTypeServicon/>>

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SEPaLS	<i>Function to estimate SEPaLS estimators</i>
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### Description

Function to estimate SEPaLS estimators

### Usage

```
SEPaLS(  
  X,  
  Y,  
  yn,  
  type = c("vMF", "Laplace"),  
  mu0 = NULL,  
  kappa0 = NULL,  
  lambda = NULL  
)
```

**Arguments**

<code>X</code>	$(n \times p)$ -dimensional matrix of the covariates.
<code>Y</code>	$(n)$ -dimensional vector of the response.
<code>yn</code>	$y_n$ the quantile corresponding to lowest values of $Y$ s to put in the tail.
<code>type</code>	character, whether vMF for von Mises-Fisher prior or Laplace for Laplace prior. See details.
<code>mu0</code>	$\mu_0$ , unitary $(p)$ -dimensional vector. The direction parameter for the vMF prior.
<code>kappa0</code>	$\kappa_0$ , positive. The concentration parameter for the vMF prior.
<code>lambda</code>	$\lambda$ , positive. The concentration parameter for the Laplace prior.

**Details**

The SEPaLS estimators are built depending on the value given to `type`:

- vMF: then the estimator is proportional to

$$\hat{\beta}_{ml}(y_n) + \kappa_0 \mu_0,$$

where  $\hat{\beta}_{ml}(y_n)$  is the EPLS estimator, which coincides with the maximum-likelihood estimator of SEPaLS for a threshold  $y_n$ .

- Laplace: then the estimator is proportional to

$$S_\lambda \left( \hat{\beta}_{ml}(y_n) \right),$$

where  $S_\lambda$  is the soft-thresholding operator of threshold  $\lambda$ .

**Value**

A SEPaLS estimator

**See Also**

[bootstrap.SEPaLS](#)

**Examples**

```
set.seed(1)
n <- 3000
p <- 10
X <- matrix(rnorm(n*p),n,p)
beta <- c(5:1,rep(0,p-5)) ; beta <- beta/sqrt(sum(beta^2))
Y <- (X%*%beta)^3 + rnorm(n,sd=1/3)
mu0 <- rnorm(p) ; mu0 <- mu0/sqrt(sum(mu0^2))
sepals_vMF <- SEPaLS(X,Y,yn=1,type="vMF",mu0=mu0,kappa0=1)
sepals_Laplace <- SEPaLS(X,Y,yn=1,type="Laplace",lambda=0.01)
```

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