Package 'sobolnp'

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Type Package

Title Nonparametric Sobol Estimator with Bootstrap Bandwidth

Version 0.2.0

Description Algorithm to estimate the Sobol indices using a non-parametric fit of the regression curve. The bandwidth is estimated using bootstrap to reduce the finite-sample bias. The package is based on the paper Solís, M. (2021) <doi:10.1080/03610918.2019.1655575>.

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URL https://github.com/maikol-solis/sobolnp/

BugReports https://github.com/maikol-solis/sobolnp/issues

Imports np, parallel, pbmcapply

Suggests testthat (>= 3.0.0)

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Encoding UTF-8

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NeedsCompilation no

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Contents

plot.sobolnp 2
print.sobolnp 3
sobolnp 4

Index **6**

`plot.sobolnp` *Plot method for objects* `sobolnp`

Description

Bar plot of the first order Sobol indices estimated by `sobolnp`, with the cross-validation and the bootstrap bandwidth side by side for each variable.

Usage

```
## S3 method for class 'sobolnp'
plot(
  x,
  ylim = NULL,
  xlab = "Variables",
  ylab = "First order Sobol indices",
  col = c("#0072B2", "#E69F00"),
  legend.pos = "topright",
  ...
)
```

Arguments

`x`	an object of class `sobolnp`.
`ylim`	limits of the y axis. By default from 0 to the larger of 1 and the largest estimated index.
`xlab, ylab`	axis labels.
`col`	colors for the cross-validation and bootstrap bars.
`legend.pos`	position of the legend, passed to `legend`. Use `NULL` to omit it.
`...`	further graphical arguments passed to `barplot`.

Value

The object `x`, invisibly. Called for its side effect of drawing a plot.

Examples

```
ishigami.fun <- function(X) {
A <- 7
B <- 0.1
sin(X[, 1]) + A * sin(X[, 2])^2 + B * X[, 3]^4 * sin(X[, 1])
}

X <- matrix(runif(3*100, -pi, pi), ncol = 3)
Y <- ishigami.fun(X)

estimation <- sobolnp(Y = Y, X = X, nboot = 5)
```

```
plot(estimation)
```

`print.sobolnp` *Print method for objects* `sobolnp`

Description

Print method for objects `sobolnp`

Usage

```
## S3 method for class 'sobolnp'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

`x`	an object of class `sobolnp`.
`digits`	minimal number of significant digits, see `print.default`.
`...`	further arguments passed to `print.default`.

Value

The object `x`, invisibly. Called for its side effect of printing the estimated indices and bandwidths.

Examples

```
ishigami.fun <- function(X) {
A <- 7
B <- 0.1
sin(X[, 1]) + A * sin(X[, 2])^2 + B * X[, 3]^4 * sin(X[, 1])
}

X <- matrix(runif(3*100, -pi, pi), ncol = 3)
Y <- ishigami.fun(X)

estimation <- sobolnp(Y = Y, X = X, nboot = 5)

print(estimation)
```

sobolnp *Nonparametric Sobol Estimator with Bootstrap Bandwidth*

Description

Algorithm to estimate the Sobol indices using a non-parametric fit of the regression curve. The bandwidth is estimated using bootstrap to reduce the finite-sample bias.

Usage

```
sobolnp(
  Y,
  X,
  bandwidth = NULL,
  bandwidth.compute = TRUE,
  bootstrap = TRUE,
  nboot = 100,
  ckerorder = 2,
  mc.cores = 1,
  verbose = TRUE
)
```

Arguments

Y	Response continuous variable
X	Numeric matrix or data frame of independent variables, with one row per element of Y. Unnamed columns are labelled X1, ..., Xp.
bandwidth	NULL or a positive numeric vector of length 1 or ncol(X) (one bandwidth per variable). If bandwidth.compute = TRUE, it sets the starting value of the least-squares cross-validation search; if NULL np chooses the starting values. If bandwidth.compute = FALSE, the bandwidths are used as given and must be supplied. Defaults to NULL.
bandwidth.compute	Logical value. Indicates if the bandwidth should be estimated or not. Defaults to TRUE.
bootstrap	Logical value. Indicates if the estimation should be with bootstrap or not. Defaults to TRUE.
nboot	Number of bootstrap samples taken for the method. Ignored if 'bootstrap = FALSE'. Defaults to 100.
ckerorder	Numeric value specifying kernel order (should be one of (2,4,6,8)). Defaults to 2.
mc.cores	Number of cores used. Defaults to 1.
verbose	Logical value. If TRUE (default), report progress messages and progress bars.

Details

For each input X_i, the regression curve $E[Y|X_i]$ is estimated by kernel regression with a least-squares cross-validation (CV) bandwidth, and `S` is the variance of the fitted curve divided by the variance of `Y`.

With `bootstrap = TRUE`, the residuals of the CV fit are standardized with a kernel estimate of their scale and resampled to build `nboot` bootstrap responses. For a bandwidth h, the bootstrap curves give a bias-corrected curve $2\hat{m}_{CV} - \bar{m}^*_h$ and a bootstrap index. The bootstrap bandwidth `bwsboot` minimizes the mean squared distance between the bootstrap indices and `S`, searching between `bws / 1000` and `bws`, and `Sboot` is the mean bootstrap index at that bandwidth.

Value

A list of class `sobolnp` with the following elements:

call The matched call.

num.obs, num.var Number of observations and of input variables.

S First order Sobol indices estimated with nonparametric regression and a cross-validation bandwidth

bws Bandwidth estimated with cross-validation

Sboot First order Sobol indices estimated with nonparametric regression and a bootstrap bandwidth

bwsboot Bandwidth estimated with bootstrap

`Sboot` and `bwsboot` are `NULL` when `bootstrap = FALSE`.

References

Solís, M. (2021). Non-parametric estimation of the first-order Sobol indices with bootstrap bandwidth. *Communications in Statistics - Simulation and Computation*, 50(9), 2497-2512. doi:10.1080/03610918.2019.1655575

Examples

```
ishigami.fun <- function(X) {
A <- 7
B <- 0.1
sin(X[, 1]) + A * sin(X[, 2])^2 + B * X[, 3]^4 * sin(X[, 1])
}

X <- matrix(runif(3*100, -pi, pi), ncol = 3)
Y <- ishigami.fun(X)

estimation <- sobolnp(Y = Y, X = X, nboot = 5)
```

Index

barplot, *2*

legend, *2*

plot.sobolnp, 2
print.default, *3*
print.sobolnp, 3

sobolnp, *2*, 4