

Package ‘topsa’

September 24, 2020

Type Package

Title Topological Sensitivity Analysis

Version 0.1.0

Maintainer Maikol Solís <maikol.solis@ucr.ac.cr>

Description Estimate geometric sensitivity indices reconstructing the embedding manifold of the data. The reconstruction is done via a Vietoris Rips with a fixed radius. With the homology of order 2 we estimate symmetric reflections of the those manifold to determine a sensitivity index on of the input model. Detailed information of the methods can be found in <<https://www.dropbox.com/s/0kcrjhkh17899n1/article-symmetric-reflection.pdf>> (WIP preprint).

License MIT + file LICENSE

URL <https://github.com/maikol-solis/topsa>

BugReports <https://github.com/maikol-solis/topsa/issues>

Encoding UTF-8

LazyData true

Imports ggplot2, scales, sf, TDA, parallel, methods

RoxygenNote 7.1.0

Depends R (>= 3.6.0)

Suggests testthat (>= 2.1.0)

NeedsCompilation no

Author Maikol Solís [aut, cre],
Alberto Hernández [ctb],
Ronald A. Zuñiga-Rojas [ctb],
Carlos Pasquier [ctb]

Repository CRAN

Date/Publication 2020-09-24 09:00:02 UTC

R topics documented:

barcode_plotter	2
plot_topsa	3
print_topsa	4
topsa	5
Index	7

barcode_plotter	<i>Barcode plotter</i>
-----------------	------------------------

Description

Barcode plotter

Usage

```
barcode_plotter(  
  Ydat,  
  Xdat,  
  maxscale = rep(0.05, ncol(Xdat)),  
  mc.cores = parallel::detectCores(logical = FALSE)  
)
```

Arguments

- Ydat A vector with the model’s dependent variable.
- Xdat A matrix with the model’s input variables.
- maxscale Maximum radius allowed to find the barcode.
- mc.cores Number of cores used to estimate the barcodes in parallel. (See [mclapply](#)).

Value

A plot with the barcode for each variable.

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)  
  
barcode_plotter(Ydat = Y, Xdat = X, maxscale = 0.2, mc.cores = 2)
```

plot_topsa	<i>plot topsa objects</i>
------------	---------------------------

Description

Plot method for objects of class topsa.

Usage

```
plot_topsa(topsaObj, nvar = "all", ...)
```

Arguments

topsaObj	an object of class topsa
nvar	it could be a sequence from 1 to the number of variables indicating which variables should be plotted. It could be the character 'all' for plot all the variables.
...	further arguments passed to the plot function

Value

A plot of generated with the output of topsa. For each variable in the model, it creates the plot of the corresponding manifold, its symmetric reflection and its symmetric difference.

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*50, -pi, pi), ncol = 3)
Y <- ishigami.fun(X)

estimation <- topsa(Ydat = Y, Xdat = X)

plot_topsa(estimation)
```

print_topsa	<i>print topsa objects</i>
-------------	----------------------------

Description

Print method for objects of class topsa.

Usage

```
print_topsa(topsaObj, only.return.table = FALSE, ...)
```

Arguments

topsaObj	an object of class topsa
only.return.table	if TRUE, returns a data frame with the estimated values. Otherwise, print the data frame in console. Defaults to FALSE
...	further arguments passed to the plot function

Value

Print the threshold used, the box area, manifold embedding area, geometric correlation index and symmetric sensitivity index for and object of class topsa.

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*50, -pi, pi), ncol = 3)
Y <- ishigami.fun(X)

estimation <- topsa(Ydat = Y, Xdat = X)

print(estimation)
```

topsa	<i>Topological Sensitivity Analysis</i>
-------	---

Description

Topological Sensitivity Analysis

Usage

```
topsa(Ydat, Xdat, threshold.radius = rep(0.05, ncol(Xdat)), method = "Alpha")
```

Arguments

Ydat	numeric vector of responses in a model.
Xdat	numeric matrix or data.frame of covariables.
threshold.radius	percent of radius or sizes of triangles to keep. the homology complex. Defaults to '0.05'. complex
method	type of method to build the homology complex. Two choices are accepted: Alpha o VR (Vietoris-Rips).

Value

A list of class topsa with the following elements:

call The function call.

Xdat X input.

Ydat Y output.

dimension dimension to estimate the homology order.

threshold cutoff level for the radius or area.

results A list for each variable with:

threshold threshold used to limit the radius or area.

Manifold_Area geometrical area of the estimated manifold.

Box.Area geometrical area of the estimated manifold.

Geometric.R2 geometric correlation between each x and y.

Geometric.Sensitivity symmetric sensitivity index of each estimated manifold.

manifold_plot a sf object with the estimated manifold.

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*50, -pi, pi), ncol = 3)  
Y <- ishigami.fun(X)  
estimation <- topsa(Ydat = Y, Xdat = X, method = "Alpha")
```


Index

barcode_plotter, [2](#)

mclapply, [2](#)

plot_topsa, [3](#)

print_topsa, [4](#)

topsa, [5](#)