Package ‘IDSA’

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Type Package
Title An Interactive Detector for Spatial Associations
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Description Method of interactive detector for spatial associations (IDSA)
   IDSA is used to quantify the power of interactive determinant (PID)
   between a spatial response variable and explanatory variables.
   IDSA is developed based on methods of spatial heterogeneity.
Imports GD, stats, ggplot2, reshape2, utils, graphics, kableExtra
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discretize

Spatial discretization.

Usage

discretize(x, n, method)

Arguments

x A numeric vector to be discretized
n A number of breaks
method A character of discretization method

Value

A vector of discretized variable of x.

Examples

x.disc <- discretize(x = runif(12), n = 3, method = "quantile")
table(x.disc)
fuzzyoverlay

Spatial fuzzy overlay.

Description
Spatial fuzzy overlay.

Usage
fuzzyoverlay(y, layers, method = "fuzzyAND")

Arguments
y A numeric vector of a response variable
layers A data frame of spatial layers of explanatory variables.
method A character of overlay methods, including "fuzzyAND" and "fuzzyOR"

Value
A data frame of a spatial fuzzy overlay variable.

Examples
library(GD)
data <- sim[, 4:6]
data.disc <- apply(data, 2, FUN = function(x) disc(x, 4, "quantile"))
layers <- do.call(cbind, lapply(1:ncol(data), function(x)
    data.frame(cut(data[, x], data.disc[[x]]$itv, include.lowest = TRUE))))
names(layers) <- names(data)
fo <- fuzzyoverlay(y = sim[,1], layers = layers, method = "fuzzyAND")

idsa

IDSA model with spatial discretization parameters.

Description
IDSA model with spatial discretization parameters.

Usage
idsa(formula, location, data, ndisc, methoddisc,
      methodoverlay = "fuzzyAND")
loessoptidisc

Arguments

- **formula**: A formula of spatial variables
- **location**: A character vector of location names in a data frame
- **data**: A data frame of dataset
- **ndisc**: A numeric vector of break numbers for respective explanatory variables
- **methoddisc**: A character vector of discretization methods
- **methodoverlay**: A character of spatial overlay methods, including "fuzzyAND" and "intersection"

Value

A list of IDSA results.

Examples

```r
q.fand <- idsa(formula = y ~ xa + xb + xc, location = c("lo", "la"),
                data = sim, ndisc = c(4,6,6), methoddisc = "quantile",
                methodoverlay = "fuzzyAND")
q.ints <- idsa(formula = y ~ xa + xb + xc, location = c("lo", "la"),
               data = sim, ndisc = c(4,6,6), methoddisc = "quantile",
               methodoverlay = "intersection")
```

loessoptidisc

Strategy 2: Optimal spatial data discretization for individual variables based on SPADE model.

Description

Strategy 2: Optimal spatial data discretization for individual variables based on SPADE model.

Usage

loessoptidisc(x, y)

Arguments

- **x**: A numeric vector of break numbers
- **y**: A numeric vector of q values

Value

A list of an optimal number of discretization and a plot.

Examples

```r
lod <- loessoptidisc(x = 4:15, y = log(4:15 + runif(12)))
```
**optidiscqs1**

*Strategy 1: Optimal spatial data discretization for individual variables based on SPADE model.*

**Description**

Strategy 1: Optimal spatial data discretization for individual variables based on SPADE model.

**Usage**

```r
optidiscqs1(y, x, location, ndisc, methoddisc)
```

**Arguments**

- `y` A numeric vector of a response variable
- `x` A numeric vector of an explanatory variable
- `location` A matrix of spatial locations
- `ndisc` A number of discretization
- `methoddisc` A character of discretization methods

**Value**

A list of an optimal spatial discretization using strategy 1.

**Examples**

```r
od <- optidiscqs1(y = sim[, 1], x = sim[, 4:6], location = sim[, 2:3],
                   ndisc = c(3:5), methoddisc = c("quantile", "equal"))
```

**plotdisc**

*Plot spatial discretization matrix.*

**Description**

Plot spatial discretization matrix.

**Usage**

```r
plotdisc(discmatrix, group)
```

**Arguments**

- `discmatrix` A matrix of spatial discretization
- `group` A vector of groups
Value

A data frame of spatial discretization matrix, which includes mean Q values in each group.

Examples

```r
library(GD)
f1 <- formula(NDVIchange ~ Tempchange + Precipitation + Popdensity)
odc1 <- optidisc(f1, ndvi_40, discmethod = "quantile", discitv = c(3:20))
xvar <- all.vars(f1)[-1]
nx <- length(xvar)
dm <- do.call(data.frame, lapply(1:nx, function(u) odc1[[u]]$qv.matrix))
names(dm) <- xvar
pd <- plotdisc(discmatrix = dm, group = rep(1:6, each = 3))
```

qs

Power of spatial determinant (PSD).

Description

Power of spatial determinant (PSD).

Usage

```r
qs(y, xh, location)
```

Arguments

- `y` A numeric vector of a response variable
- `xh` A character variable, a data frame or a matrix of explanatory variables
- `location` A matrix of spatial locations

Value

A power of spatial determinant (PSD) value.

Examples

```r
# an explanatory variable
library(GD)
data.disc <- disc(sim$xa, 4, "quantile")
xh <- cut(sim$xa, data.disc$itv, include.lowest = TRUE)
qs(sim$y, xh, location = sim[, c("lo","la")])
# multiple explanatory variables
data <- sim[,4:6]
data.disc <- apply(data, 2, FUN = function(x) disc(x, 4, "quantile"))
xh <- do.call(cbind, lapply(1:ncol(data), function(x)
  data.frame(cut(data[, x], data.disc[[x]]$itv, include.lowest = TRUE))))
```
Names(xh) <- names(data)
qs(sim$y, xh, location = sim[, c("lo","la")])

Description

Power of spatial and multilevel discretization determinant (PSMD) of SPADE model for an individual explanatory variable.

Usage

qs1(y, x, xh, location)

Arguments

y A numeric vector of a response variable
x A numeric vector of an explanatory variable
xh A character variable of an explanatory variable
location A matrix of spatial locations

Value

A data frame of PSMD values.

Examples

library(GD)
data.disc <- disc(sim$xa, 4, "quantile")
xh <- cut(sim$xa, data.disc$itv, include.lowest = TRUE)
qs1(y = sim$y, x = sim$xa, xh = xh, location = sim[, c("lo","la")])
qs2

Power of interactive determinant for multiple explanatory variables in IDSA model.

Description

Power of interactive determinant for multiple explanatory variables in IDSA model.

Usage

qs2(y, x, xoverlay, location)

Arguments

y
A numeric vector of a response variable

x
A numeric vector of an explanatory variable

xoverlay
A character variable of an explanatory variable

location
A matrix of spatial locations

Value

A power of interactive determinant (PID) value from IDSA model.

Examples

library(GD)
data <- sim[,4:6]
data.disc <- apply(data, 2, FUN = function(x) disc(x, 4, "quantile"))
layers <- do.call(cbind, lapply(1:ncol(data), function(x)
  data.frame(cut(data[, x], data.disc[[x]]$itv, include.lowest = TRUE)))))
names(layers) <- names(data)
fo <- fuzzyoverlay(y = sim[,1], layers = layers, method = "fuzzyAND")
q.idsa <- qs2(y = sim$y, x = data, xoverlay = fo$fuzzylayer,
  location = sim[, c("lo","la")])

qs2all

IDSA of all combinations

Description

IDSA of all combinations

Usage

qs2all(y, x, xh, location, method = "fuzzyAND")
Arguments

\begin{itemize}
\item $y$ A numeric vector of a response variable
\item $x$ A numeric vector of an explanatory variable
\item $x_h$ A character variable of an explanatory variable
\item location A matrix of spatial locations
\item method A character of overlay methods
\end{itemize}

Value

A data frame of all possible power of interactive determinants (PID) values from IDSA models.

Examples

```r
library(GD)
x <- sim[,4:6]
x.disc <- apply(x, 2, FUN = function(u) disc(u, 4, "quantile"))
xh <- do.call(cbind, lapply(1:ncol(x), function(u)
    data.frame(cut(x[, u], x.disc[[u]]$itv, include.lowest = TRUE)))))
names(xh) <- names(x)
qidsa.all <- qs2all(y = sim$y, x = x, xh = xh,
    location = sim[, c("lo","la")])
```

Description

PSD with an overlay variable.

Usage

\texttt{qsoverlay(x, xoverlay, location)}

Arguments

\begin{itemize}
\item $x$ A numeric vector of a explanatory variable
\item $x_{overlay}$ A character variable of an explanatory variable
\item location A matrix of spatial locations
\end{itemize}

Value

A PSD value of an overlay variable.
Examples

```r
library(GD)
data <- sim[, 4:6]
data.disc <- apply(data, 2, FUN = function(x) disc(x, 4, "quantile"))
layers <- do.call(cbind, lapply(1:ncol(data), function(x)
  data.frame(cut(data[, x], data.disc[[x]]$itv, include.lowest = TRUE))))
names(layers) <- names(data)
fo <- fuzzyoverlay(y = sim[, 1], layers = layers, method = "fuzzyAND")
qo <- qsoverlay(x = data, xoverlay = fo$fuzzylayer,
  location = sim[, c("lo","la")])
```

selectaddavar

Selecting and adding a variable to improve PID.

Description

Selecting and adding a variable to improve PID.

Usage

```r
selectaddavar(y, x, xh, location, x.given, x.option,
  method = "fuzzyAND")
```

Arguments

- `y`: A numeric vector of a response variable
- `x`: A data frame or a matrix of explanatory variables
- `xh`: A data frame or a matrix of discretized explanatory variables
- `location`: A data frame of locations
- `x.given`: A name of a start variable
- `x.option`: A character vector of names of optional variables
- `method`: A character of spatial overlay method

Value

A list of process data of improving PID values by adding a variable.

Examples

```r
library(GD)
x <- sim[, 4:6]
x.disc <- apply(x, 2, FUN = function(u) disc(u, 4, "quantile"))
xh <- do.call(cbind, lapply(1:ncol(x), function(u)
  data.frame(cut(x[, u], x.disc[[u]]$itv, include.lowest = TRUE))))
names(xh) <- names(x)
sav <- selectaddavar(y = sim[, 1], x = x, xh = xh,
```
selectgd

location = sim[, c("lo","la")],
x.given = "xc", x.option = c("xa", "xb"),
method = "fuzzyAND"

selectgd

Selecting optimal interaction for GD model.

Description

Selecting optimal interaction for GD model.

Usage

selectgd(formula, data, ndisc, methoddisc)

Arguments

formula A formula of spatial variables
data A data frame of dataset
ndisc A numeric vector of break numbers for respective explanatory variables
methoddisc A character vector of discretization methods

Value

A list of process and results of optimal interaction for GD model.

Examples

s1 <- selectgd(formula = y ~ xa + xb + xc, data = sim,
ndisc = c(4,6,6), methoddisc = "quantile")

selectidsa

Selecting optimal interaction for IDSA model.

Description

Selecting optimal interaction for IDSA model.

Usage

selectidsa(formula, data, location, ndisc, methoddisc)
sigratio

Arguments

- formula: A formula of spatial variables
- data: A data frame of dataset
- location: A character vector of location names in a data frame
- ndisc: A numeric vector of break numbers for respective explanatory variables
- methoddisc: A character vector of discretization methods

Value

A list of process and results of optimal interaction for IDSA model.

Examples

```r
sim$xd <- log(sim$xa * sim$xb)
s1 <- selectidsa(formula = y ~ xa + xb + xc + xd, data = sim,
location = c("lo", "la"),
ndisc = c(4,6,6,5), methoddisc = "quantile")
```

dsigratio

Ratio of significantly different zones.

Description

Ratio of significantly different zones.

Usage

```r
sigratio(formula, data, ndisc, methoddisc, methodoverlay = "fuzzyAND")
```

Arguments

- formula: A formula of spatial variables
- data: A data frame of dataset
- ndisc: A numeric vector of break numbers for respective explanatory variables
- methoddisc: A character vector of discretization methods
- methodoverlay: A character of spatial overlay methods, including "fuzzyAND" and "intersection"

Value

A list of ratios of significantly different zones.
Examples

```r
sr1 <- sigratio(formula = y ~ xa + xb + xc, data = sim,
                ndisc = c(4,4,5), methoddisc = "quantile",
                methodoverlay = "fuzzyAND")
sr2 <- sigratio(formula = y ~ xa + xb + xc, data = sim,
                ndisc = c(4,4,5), methoddisc = "quantile",
                methodoverlay = "intersection")
sr1$n.zone; sr2$n.zone
sr1$ratio.sigdif; sr2$ratio.sigdif
```

---

**sim**

*Simulation data.*

**Description**

Simulation data.

**Usage**

```r
sim
```

**Format**

`sim`: A data frame with 713 rows and 7 variables

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**spade**

*SPADE model with spatial discretization parameters.*

**Description**

SPADE model with spatial discretization parameters.

**Usage**

```r
spade(formula, location, data, ndisc, methoddisc)
```

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>formula</td>
<td>A formula of spatial variables</td>
</tr>
<tr>
<td>location</td>
<td>A character vector of location names in a data frame</td>
</tr>
<tr>
<td>data</td>
<td>A data frame of dataset</td>
</tr>
<tr>
<td>ndisc</td>
<td>A numeric vector of break numbers for respective explanatory variables</td>
</tr>
<tr>
<td>methoddisc</td>
<td>A character vector of discretization methods</td>
</tr>
</tbody>
</table>
Value

A data frame of power of determinants (PD) of individual variables from SPADE model.

Examples

```r
q.spade <- spade(formula = y ~ xa + xb + xc, location = c("lo", "la"),
                 data = sim, ndisc = c(4,6,6), methoddisc = "quantile")
```

```r
tau

Spatial dependence parameter.
```

Description

Spatial dependence parameter.

Usage

```r
tau(y, location)
```

Arguments

- `y` A numeric vector of a response variable
- `location` A matrix of spatial locations

Value

A value of spatial dependence parameter.

Examples

```r
tau(y = sim[, 1], location = sim[, 2:3])
```
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