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)
as described in Yongze Song (2021) <doi:10.1080/13658816.2021.1882680>.
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

Depends R (>= 3.5.0)

License GPL-2

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

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R topics documented:

`discretize` *Spatial discretization.*

Description

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")
```

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

```
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")
```

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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

```
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

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

Arguments

`y`	A numeric vector of a response variable
`x`	A numeric vector of a 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

```
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

```
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

```
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))
```

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qs *Power of spatial determinant (PSD).*

Description

Power of spatial determinant (PSD).

Usage

```
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

```
# 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")])
```

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qs1 *Power of spatial and multilevel discretization determinant (PSMD) of SPADE model for an individual explanatory variable.*

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 a 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 a 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

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

Value

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

Examples

```
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")])
```

---

qsoverlay *PSD with an overlay variable.*

Description

PSD with an overlay variable.

Usage

```
qsoverlay(x, xoverlay, location)
```

Arguments

x	A numeric vector of a explanatory variable
xoverlay	A character variable of an explanatory variable
location	A matrix of spatial locations

Value

A PSD value of an 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]]$itv, include.lowest = TRUE))))
names(layers) <- names(data)
fo <- fuzzyoverlay(y = sim[,1], layers = layers, method = "fuzzyAND")
qo <- qsoverlay(x = data, xoverlay = fo$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

```
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

```
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,
```

```
                    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)
```

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

```
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")
```

---

sigratio *Ratio of significantly different zones.*

Description

Ratio of significantly different zones.

Usage

```
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

```
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

```
sim
```

Format

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

Author(s)

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spade *SPADE model with spatial discretization parameters.*

Description

SPADE model with spatial discretization parameters.

Usage

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

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

Value

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

Examples

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

---

tau *Spatial dependence parameter.*

Description

Spatial dependence parameter.

Usage

```
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

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

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