Package 'gwfa'

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Type Package

Title Geographically Weighted Fractal Analysis

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Description Performs Geographically Weighted Fractal Analysis (GWFA) to calculate the local fractal dimension of a set of points. GWFA mixes the Sandbox multifractal algorithm and the Geographically Weighted Regression. Unlike fractal box-counting algorithm, the sandbox algorithm avoids border effects because the boxes are adjusted on the set of points. The Geographically Weighted approach consists in applying a kernel that describes the way the neighbourhood of each estimated point is taken into account to estimate its fractal dimension. GWFA can be used to discriminate built patterns of a city, a region, or a whole country.

Suggests rgdal, rgeos

License GPL (>= 2)

Imports methods,Rcpp (>= 0.11.3),sp

LinkingTo Rcpp

NeedsCompilation yes

RoxygenNote 5.0.1

Repository CRAN

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R topics documented:

Grid-class *Grid class*

Description

A S4 class to define a grid, the output class of gwfa function.

Value

an object of class "Grid"

Slots

cell_size Cell size of the grid

bandwith Radius of the Kernel Density Estimator

radius Radius of the multiscale analysis

q The vector of order of the Renyi entropy

sample_size size of the sample for calculate the average of the masses for the different radius and Renyi entropy orders $M^q(R)$

Methods

`[` Gets the value of an object

`[<-` Sets the value of an object

grid_to_spdf *Transforms Grid Object into SpatialPolygonsDataFrame*

Description

Transforms Grid Object (the output of the gwfa function) into SpatialPolygonsDataFrame.

Usage

```
grid_to_spdf(df,epsg,cell_size=NULL, bandwith = NULL, radius = NULL,
  q = NULL, sample_size = NULL)
```

Arguments

`df`	the `data.frame` obtained from the gwfa function
`epsg`	EPSG code
`cell_size`	leave empty
`bandwith`	leave empty
`radius`	leave empty
`q`	leave empty
`sample_size`	leave empty

Details

Returns a spatialPolygonsdataframe.

Author(s)

Cecile Tannier, Stephane G. Roux and Francois Semecurbe

Examples

```
library(gwfa)

data("mariegalante")

test=gwfa(points=mariegalante,q=0,radius=(20*2^((0:6)/2)),
bandwith=1600,sample_size=500,cell_size=2000)
test=test[test$count>100,]#select the cells with at least 100 points.


#estimate the fractal dimension on the 7 radius
X=cbind(rep(1,length(test@radius)),log2(test@radius))
fit_frac_dim=(do.call(cbind,test[,4:10]))%*%t(solve(t(X)%*%X)%*%t(X))
test$dimfrac=fit_frac_dim[,2]

#create spatial polygon dataframe
shp=grid_to_spdf(test,"2970")
```

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guadeloupe *Centroids of buildings of Guadeloupe (French Island in Caribbean)*

Description

The guadeloupe centroids has been extracted from OpenStreetMap.

Map data copyrighted OpenStreetMap contributors and available from 'http://www.openstreetmap.org'

Value

x	longitude
y	latitude

Examples

```
## Not run:
data("guadeloupe")

plot(guadeloupe)

## End(Not run)
```

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gwfa *Geographically Weighted Fractal Analysis*

Description

Estimate local fractal dimension of a 2D set of points

Usage

```
gwfa(points, q = 0, radius, bandwith, sample_size, cell_size)
```

Arguments

points	A data.frame containing two rows "x" and "y" corresponding to the longitude and latitude of the set of points analysed
q	The vector of order of the Renyi entropy. q=0 allows calculating more robusting box-counting dimension.
radius	the vector of radius of the multi-scale analysis
bandwith	Bandwith of the GWFA. This bandwidth acts as a local-global parameter. A large bandwidth leads to a global analysis. On the contrary, a small bandwidth leads to a local analysis. The unit of measurement is free. It must be the same as the unit of cell_size variable.
sample_size	size of the sample for calculate the average of the masses for the different radius and Renyi entropy orders $M^q(R)$. The choice of sample_size is a tradeoff between precision and computing speed. In our experience, 3000 is an appropriate choice.
cell_size	Cell size of the grid. The unit of measurement is free. It must be the same as the unit of bandwith variable.

Details

GWFA is a spatial method to analyse the variability of multiscale behavior in space of set of points. The vector of radius sets the scale of the multiscale analysis whereas the bandwith describes the size of the neighborhood of the analysis. The cell_size indicate the spacing between the estimate points. sample_size is a technique parameter indicates the size of the sample of the set of points used in the analysis.

GWFA is a mix between Sandbox Multifractal analysis and Geographically Weighted Approach. The kernel used is the bisquare $(1 - (\frac{distance}{bandwith})^2)^2$

As output, we get a Grid object. A Grid class inherits from the class data.frame and it is completed by five slots (cell_size, bandwith, radius,q and sample_size) corresponding of input parameters of the gwfa function.

Author(s)

Cecile Tannier, Stephane G. Roux and Francois Semecurbe

References

Vicsek, T. (1990). Mass multifractals. Physica A: Statistical Mechanics and its Applications, 168(1), 490-497.

Brunsdon, C., Fotheringham, S., & Charlton, M. (1998). Geographically weighted regression. Journal of the Royal Statistical Society: Series D (The Statistician), 47(3), 431-443.

Examples

```
## Not run:
data("guadeloupe")

test=gwfa(points=guadeloupe,q=0,radius=(20*2^((0:6)/2)),
bandwith=1600,sample_size=3000,cell_size=2000)
test=test[test$count>100,]#select the cells with at least 100 points.


#estimate the fractal dimension on the 7 radius
X=cbind(rep(1,length(test@radius)),log2(test@radius))
fit_frac_dim=(do.call(cbind,test[,4:10]))%*%t(solve(t(X)%*%X)%*%t(X))
test$dimfrac=fit_frac_dim[,2]

#create spatial polygon dataframe
shp=grid_to_spdf(test,"2970")

#convert to geographic information systems software format
library(rgdal)
writeOGR(shp,"guade_analysis.shp","guade_analysis",driver="ESRI Shapefile",overwrite_layer = T)

#use the cartography package
library(cartography)
choroLayer(spdf=shp,nclass=5,var="dimfrac",method="fisher-jenks")

## End(Not run)
```

`mariegalante` *Centroids of buildings of Marie-Galante (French Island in Caribbean). Marie-Galante is a dependency of Guadeloupe*

Description

The Marie-Galante centroids has been extracted from OpenStreetMap.

Map data copyrighted OpenStreetMap contributors and available from 'http://www.openstreetmap.org'

Value

x	longitude
y	latitude

Examples

```
library(gwfa)

data("mariegalante")

test=gwfa(points=mariegalante,q=0,radius=(20*2^((0:6)/2)),
bandwith=1600,sample_size=500,cell_size=2000)
test=test[test$count>100,]#select the cells with at least 100 points.


#estimate the fractal dimension on the 7 radius
X=cbind(rep(1,length(test@radius)),log2(test@radius))
fit_frac_dim=(do.call(cbind,test[,4:10]))%*%t(solve(t(X)%*%X)%*%t(X))
test$dimfrac=fit_frac_dim[,2]

#create spatial polygon dataframe
shp=grid_to_spdf(test,"2970")

## Not run:

library(cartography)
choroLayer(spdf=shp,nclass=5,var="dimfrac",method="fisher-jenks")




## End(Not run)
```

Index