Package 'GeoXp'

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Suggests maptools, MatrixModels, RANN

Description GeoXp is a tool for researchers in spatial statistics,spatial econometrics, geography, ecology etc allowing to link dynamically statistical plots with elementary maps. This coupling consists in the fact that the selection of a zone on the map results in the automatic highlighting of the corresponding points on the statistical graph or reversely the selection of a portion of the graph results in the automatic highlighting of the corresponding points on the map. GeoXp includes tools from different areas of spatial statistics including geostatistics as well as spatial econometrics and point processes. Besides elementary plots like boxplots,histograms or simple scatterplot, GeoXp also couples with maps Moran scatterplots, variogram cloud, Lorentz Curves,...In order to make the most of the multidimensionality of the data, GeoXp includes some dimension reduction techniques such as PCA.

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GeoXp-package *Interactive exploratory spatial data analysis*

Description

GeoXp is a tool for researchers in spatial statistics, spatial econometrics, geography, ecology etc allowing to link dynamically statistical plots with elementary maps. This coupling consists in the fact that the selection of a zone on the map results in the automatic highlighting of the corresponding points on the statistical graph or reversely, the selection of a portion of the graph results in the automatic highlighting of the corresponding points on the map. GeoXp includes tools from different areas of spatial statistics including geostatistics as well as spatial econometrics and point processes. Besides elementary plots like boxplots, histograms or simple scatterplos, GeoXp also couples with maps Moran scatterplots, variogram cloud, Lorentz Curves,... In order to make the most of the multidimensionality of the data, GeoXp includes some dimension reduction techniques such as PCA.

Details

Package:	GeoXp
Type:	Package
Version:	1.6.1
Date:	2012-09-07
License:	GPL Vesion 2 or later

In the version 1.5.0, GeoXp has adopted the `SpatialClass` object proposed by Roger Bivand in `sp` package. The main advantage of using this structure object is on one hand, a `SpatialClass` object can contain both spatial coordinates and a `data.frame` of observed variable and on an other hand, it offers the possibility to make spatial analysis using both packages derived from `sp` as `spdep`, `gstat` and `GeoXp`.
On the map, the coordinates of sites are represented by using the function `coordinates` included in `sp` package, which calculates `longitude` (for x-axis) and `latitude` (for y-axis), applied on a Spatial Class Object.
In GeoXp, we can find three main groups of functions:
- functions using only one variable: the interest variable is designed by argument `name.var`, a character corresponding to a column of the `data.frame` included in `sp.obj`, i.e. the Spatial Class object. It can be a numeric variable (`histomap()`, `densitymap()`, `angleplotmap`...) or a factor variable (or character) (`barmap()`,...).
- functions using both several variables: the variables of interest are designed by argument `names.var`, a vector of character corresponding to columns of the `data.frame` included in `sp.obj`. It can be two numeric variables (`dblehistomap`, `dbledensitymap`), one numeric variable and one factor (`histobarmap()`, `polyboxplotmap()`), several numeric variables (`plot3dmap`, `pcamap()` and `clustermap()`).
- functions using both a variable and a spatial weight matrix created as a `nb` or `listw` object (see package `spdep`).
In the case where `sp.obj` is a `SpatialPolygonDataFrame`, user will have the opportunity to draw

the polygons of Spatial unit by using the `Draw Saptial contours` button in the Tk window. User can also give a spatial polygonal contour as background map with option `carte`: in this case, a spatial polygonal contour is a matrix of numeric values with 2 columns (x and y coordinates of the vertices of the polygons) where polygons are seperated from each other by 3 rows of NaN. The functions (`polylist2list()` and `spdf2list()`) convert some spatial objects (`Polylist` and `SpatialPolygonDataFrame`) into matrix as decribed above to draw a background map.
Among options which are common to each function, users have the possibility to give a `criteria`, vector of boolean of size the number of Spatial units, with TRUE on specific sites. These sites are then represented by a green croice on the map by clicking on `preselected sites` button on the Tk window.
Moreover, users have the possibility to make bubbles and add some graphs (histogram, barplot or scattermap). The potential variables are included in the `data.frame` of the `SpatialObject`. Users can choose a proportional symbol mapping: in function plot, we give value $var^{0.5}$. User can choose if a legend has to appear on the map. He could choose then three values represented by bubbles of corresponding sizes.
Finally, users can choose to represent the graphical with different colors using argument `col`. In the case of factors (as function `barmap`), users could choose if a legend with corresponding colors will appear on the map. Users can also modify the representation of selected sites on map with argument `pch`.
Recent functions `barnbmap` and `histnbmap` give the opportunity to analyse spatial weight matrix build using functions included in `spdep` package.

Author(s)

Christine Thomas-Agnan, Yves Aragon, Anne Ruiz-Gazen, Thibault Laurent, Laurianne Robidou
Maintainer: Thibault Laurent <thibault.laurent@univ-tlse1.fr>

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

`angleplotmap` *Detection of an eventual directional trend*

Description

The function `angleplotmap()` is used to detect an eventual directional trend associated to variable `name.var`. It represents the absolute difference between the value of `name.var` at two sites as a function of the angle between vector $\overrightarrow{s_i s_j}$ and the x-axis.

Usage

```
angleplotmap(sp.obj, name.var, quantiles=TRUE, names.attr=names(sp.obj),
criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3",
xlab="angle", ylab="absolute magnitude", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
name.var	a character; attribute name or column number in attribute table
quantiles	a boolean to represent the Additive Quantile Regression Smoothing
names.attr	a vector of character: names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean which permit to represent preselected sites with a cross, using the tcltk window (must be equal to the number of spatial units)
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the cloud map
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

For each couple of sites (s_i, s_j), the graphic represents on the y-axis the absolute difference between var_i and var_j :

$$D_{ij} = |var_i - var_j|$$

and on the x-axis the angle θ_{ij} between $\overrightarrow{s_i s_j}$ and the x-axis. Possibility to represent a smoothing spline regression quantile g_α. For $0 < \alpha < 1$,

$$Pr[D_{ij} < g_\alpha(\theta ij)] = \alpha$$

If that case, only the pair of sites (s_i, s_j) verifying :

$$D_{ij} > g_{max(\alpha)}(\theta ij)$$

are represented.

Value

In the case where user click on `save results` button, a matrix of integer is created as a global variable in `last.select` object. It corresponds to the numbers of spatial unit corresponding to couple of sites selected just before leaving the Tk window.

Author(s)

Thomas-Agnan Christine, Aragon Yves, Ruiz-Gazen Anne, Laurent Thibault, Robidou Lauriane

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

variocloudmap,driftmap

Examples

```
######
# data Conflicts Africa
data(afcon)

# afcon is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
afcon.sp = SpatialPoints(cbind(afcon$x,afcon$y))
# ... and then by integrating other variables to create SpatialPointsDataFrame
afcon.spdf = SpatialPointsDataFrame(afcon.sp, afcon)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
require("maptools")
africa <- readShapePoly(system.file("shapes/Africa.shp", package = "GeoXp")[1])
africa.contour<-spdf2list(africa)$poly

# A basic call of histomap function
angleplotmap(afcon.spdf,"totcon", carte= africa.contour,
identify=TRUE, cex.lab=0.6)


#####
# Data Meuse
data(meuse)
```

```
# meuse is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
meuse.sp = SpatialPoints(cbind(meuse$x,meuse$y))
# ... and then by integrating other variables to create SpatialPointsDataFrame
meuse.spdf = SpatialPointsDataFrame(meuse.sp, meuse)

# meuse.riv is used for contour plot
data(meuse.riv)

angleplotmap(meuse.spdf,"copper",
col="green",quantiles=TRUE, cex.lab=0.7,
xlab="Concentration in plomb (in ppm)",pch=7,carte=meuse.riv[c(21:65,110:153),])
```

---

barmap *Interactive Bar plot and map*

Description

The function barmap() draws a bar plot (vertical bar) of the given factor variable name.var and a map with sites of coordinates coordinates(sp.obj).

Usage

```
barmap(sp.obj, name.var, type = c("count","percent"), names.arg="",
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3", xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
name.var	a character; attribute name or column number in attribute table
type	Character string indicating type of histogram to be drawn. "percent" and "count" give relative frequency and frequency histograms.
names.arg	a vector of level names of name.var
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number os spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	a vector of symbol which must be equal to the number of level else all sites are printed whith pch[1]

col	a vector of colors which must be equal to the number of level else all sites and all bars are printed with col[1]
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

The selection of a bar on the bar plot results in the corresponding sites coloured on the map with the corresponding colour observed on the bar. Reversely, the selection of sites on the map by "points" or "polygon" results in the drawing of the sub-barplot in red.

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

`histomap`, `histobarmap`, `scattermap`, `densitymap`

Examples

```
######
# data eire
require("maptools")
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))

# a basic usage ...
barmap(eire,"pale")

# ... with all options
```

```
barmap(eire,3, type = "percent",col=c("pink","orange"),
names.arg=c("not pale","pale"), names.attr=names(eire),
criteria=NULL, identify=TRUE, cex.lab=0.8, pch=c(10,11),
xlab="Are majority people are pale ?", ylab="Percent",
axes=TRUE, lablong="longitude", lablat="latitude")
```

---

barnbmap *Bar plot of the number of neighbour and map*

Description

The function barnbmap draws the bar plot of the link number distribution for a neighbourhood structure given by a nb object (spdep package) and links this bar plot with a map.

Usage

```
barnbmap(sp.obj, nb.obj,
criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3",
xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
nb.obj	object of class nb
criteria	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the barplot
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

For a selected site j on the map, are represented on the map its neighbours. For a selected bar on the graph, the corresponding sites are represented on the map with a link which means that two sites are neighbours.

Value

No value returned.

Note

When user select sites on the graph or on the map, he cannot add a selection by using the other graphic.

Author(s)

Thomas-Agnan C., Ruiz-Gazen A., Laurent T.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

moranplotmap,makeneighborsw,normw,nonormmoran

Examples

```
######
# data on price indices of real estate in France
data(immob)
row.names(immob)<-immob$Nom

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))

# Spatial weight matrix based on nearest neighbours
immob.nb <- dnearneigh(coordinates(immob.sp), 0,175000)

# a simple use of barnbmap
barnbmap(immob.sp,immob.nb)

######
# Data columbus
require("maptools")
example(columbus)

# col.gal.nb is a spatial weight matrix included in spdep package...
barnbmap(columbus,col.gal.nb,criteria=(columbus$EW==1),
col=colors()[98:106], identify=TRUE, cex.lab=0.7, pch=1:9)
```

boxplotmap *Interactive boxplot and map*

Description

The function boxplotmap() draws a boxplot of the given variable name.var and a map with site of coordinates coordinates(sp.obj).

Usage

```
boxplotmap(sp.obj, name.var, names.attr=names(sp.obj), criteria=NULL,
carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3",
xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
name.var	a character; attribute name or column number in attribute table
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of spatial sites, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the boxplot
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

There is an interactivity only in one direction : the sites selected by interquartile on the boxplot are represented on the map in red.

Value

In the case where user click on save results button, a vector of integer is created as a global variable in last.select object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

histomap, histobarmap, scattermap, densitymap

Examples

```
######
# data columbus
require("maptools")
example(columbus)

# a basic use of boxplotmap
boxplotmap(columbus,"CRIME", criteria=(columbus@data$CP==1),
xlab="Crime",ylab="Percent",identify=TRUE, cex.lab=0.7)

######
# data boston
data(boston)

# creation of a Spatial object
boston.sp = SpatialPoints(cbind(boston.c$LON,boston.c$LAT))
# ... and then by integrating other variables to create SpatialPointsDataFrame
boston.spdf = SpatialPointsDataFrame(boston.sp, boston.c)

# a simple use of boxplotmap
boxplotmap(boston.spdf,"MEDV",criteria=(boston.c$CHAS==1))
```

---

carte *Drawing a map*

Description

The function carte() draws a map with sites of coordinates (long,lat) and represents sites which have been selected in obs. This function is called by most of the functions of GeoXp (this is not an interactive function).

Usage

```
carte(long, lat, obs, sp.obj=NULL, criteria=NULL, buble=FALSE, cbuble=NULL, nointer=FALSE,
carte=NULL,nocart=FALSE, label="",cex.lab=NULL, symbol=16, lablong="",
lablat="", method="", W=NULL,couleurs="blue", classe=NULL, legmap=NULL,
legends=list(FALSE,FALSE),labmod="",axis=FALSE)
```

Arguments

long	a vector x of size n
lat	a vector y of size n
obs	a boolean vector of size n with TRUE on selected sites
sp.obj	a SpatialPolygonsDataFrame object
criteria	a vector of size n of boolean with TRUE on specific sites (these for non interactive selection)
buble	a boolean with TRUE for drawing bubbles, FALSE otherwise
cbuble	vector of size n with size of each site depending on variable with which bubbles are constructed
nointer	a boolean with TRUE for drawing sites selected by criteria, FALSE otherwise
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
nocart	a boolean with TRUE for drawing spatial contours, FALSE otherwise
label	vector of character of size n with name of each site
cex.lab	character size of label
symbol	a vector of symbol which must be equal to the number of group else all sites are printed in pch[1]
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map
method	Specification for some graphics such as 'Neighbourplot1', 'Neighbourplot2', 'Cluster', 'Angleplot', 'Variocloud'
W	neighbourhood matrix of size $n \times n$, necessary when method='Neighbourplot'
couleurs	Colors of the sites
classe	vector of n whith class of sites
legmap	a list of (numeric,numeric,numeric,numeric,numeric,numeric,character) with the sizes and the corresponding values of the 3 bubbles represented in the legend and the variable name of variable choosed
legends	a list of c(boolean,boolean,c(numeric,numeric),c(numeric,numeric)) with TRUE for drawing legends of bubbles (1st argument) or factors (2nd argument) and the coordinates of the location of the upper left corner of the legend box
labmod	Name of factors
axis	a boolean with True for drawing axes on the map

Details

Options permit to represent sites with different colors or symbols, with different sizes of circle ('bubble'), using a spatial contour ('carte'), printing names of sites ('label'),etc. Possibility to draw a legend giving the sizes of bubbles and colors of levels.

Value

No values, only drawing of a map

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

---

choix.bubble *Selection of a variable before plotting bubbles*

Description

The function `choix.bubble()` is used in most of the GeoXp functions to initialize some parameters before plotting bubbles.

Usage

```
choix.bubble(buble,listvar,listnomvar,legends)
```

Arguments

`buble`	boolean
`listvar`	list of variables
`listnomvar`	names of variables
`legends`	parameters of plot

Details

This function is not an interactive function.

Value

A list of parameters which permit to use the function carte.

Author(s)

Laurent T.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

`choix.couleur` *Selection of colors before plotting map*

Description

The function `choix.couleur()` is used in most of the GeoXp functions to initialize some parameters before plotting map in the case of the use of a factor.

Usage

```
choix.couleur(graphChoice,listvar=NULL,listnomvar=NULL,
varChoice1=NULL,legends,col,pch,spdf=FALSE)
```

Arguments

`graphChoice`	kind of graphic chosen
`listvar`	list of variables
`listnomvar`	names of variables
`varChoice1`	the name of the chosen variable
`legends`	parameters of plot
`col`	color of plot
`pch`	symbols
`spdf`	a boolean

Details

This function is not an interactive function.

Value

A list of parameters which permit to use the function carte.

Author(s)

Laurent T.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

choixvarfunc *Selection of a variable before plotting bubbles*

Description

The function `choixvarfunc()` is used in the function `choix.bubble()`.

Usage

```
choixvarfunc(title, question, liste)
```

Arguments

`title`	a character as "Choice of variables"
`question`	a character as "Choose a variable"
`liste`	a list of character with names of variables

Details

This function is not an interactive function.

Value

Name of variable chosen.

Author(s)

Laurent T.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

clustermap *Classification of dataset using kmeans or hclust algorithm and representation of clusters on a map.*

Description

The function `clustermap()` performs a classification of the sites from the variables called in `names.var` and computes a bar plot of the clusters calculated. Classification methods come from `hclust()` (hierarchical cluster analysis) and `kmeans()` (k-means clustering) and number of class is chosen with `clustnum`.

Usage

```
clustermap(sp.obj, names.var, clustnum, method=c("kmeans","hclust"), type=NULL,
centers=NULL, scale=FALSE, names.arg="", names.attr=names(sp.obj), criteria=NULL,
carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3",
xlab="Cluster", ylab="Number", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
names.var	a vector of character; attribute names or column numbers in attribute table
clustnum	integer, number of clusters
method	two methods : 'kmeans' by default or 'hclust'
type	If method='hclust', type='complete' by default (the possibilities are given in help(hclust) as 'ward', 'single', etc). If method='kmeans', type="Hartigan-Wong" by default (the possibilities are given in help(kmeans) as 'Forgy', etc)
centers	If method='kmeans', user can give a matrix with initial cluster centers.
scale	If scale=TRUE, the dataset is reducted.
names.arg	a vector of character, names of cluster
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	a vector of symbol which must be equal to the number of group else all sites are printed in pch[1]
col	a vector of colors which must be equal to the number of group else all sites and all bars are printed in col[1]
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

The two windows are interactive : the sites selected by a bar chosen on the bar plot are represented on the map in red and the values of sites selected on the map by 'points' or 'polygon' are represented in red on the bar plot. The dendogram is also drawn for 'hclust' method. In option, possibility to choose the classification method.

Value

In the case where user click on `save results` button, a list is created as a global variable in `last.select` object. `obs`, a vector of integer, corresponds to the number of spatial units selected just before leaving the Tk window, `vectclass`, vector of integer, corresponds to the number of cluster attributed to each spatial unit.

Note

To use the functions `hclust` and `kmeans`, we take many arguments by default. If the user would like to modify these arguments, he should call these functions first and then use the function `barmap` to visualize the calculated clusters.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Murtagh, F (1985). *Multidimensional Clustering Algorithms*.

Hartigan, J. A. and Wong, M. A. (1979). A K-means clustering algorithm. Applied Statistics 28, 100-108

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

`barmap`, `pcamap`

Examples

```
#####
# data columbus
require("maptools")
example(columbus)

# a basic example using the kmeans method
clustermap(columbus, c("HOVAL","INC","CRIME","OPEN","PLUMB","DISCBD"), 3,
criteria=(columbus@data$CP==1), identify=TRUE, cex.lab=0.7)

# example using the hclust method
clustermap(columbus,c(7:12), 3, method="hclust",
```

```
criteria=(columbus@data$CP==1),col=colors()[20:22],identify=TRUE,
cex.lab=0.7, names.arg=c("Group 1","Group 2","Group 3"), xlab="Cluster")
```

---

dbledensitymap *Double Kernel density estimates and map*

Description

The function dbledensitymap plots two kernel density estimates from 2 variables included in names.var computed with bkde, and a map with sites of coordinates coordinates(sp.obj). Each site is associated to a value of names.var[1] and names.var[2] and the two windows are interactive.

Usage

```
dbledensitymap(sp.obj, names.var, kernel='triweight',
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8, pch=16,
col=c("grey","lightblue3"), xlab=c("",""), ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
names.var	a vector of character of size 2; attribute names or column numbers in attribute table
kernel	Smoothing kernel (see help(bkde) for list of options)
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	c("grey","lightblue3") by default, color of the two density curves
xlab	a list of title for the two x-axis graphics
ylab	a list of title for the two y-axis graphics
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

The user can choose an interval on the density curve by mouse clicking on the lower and upper boundaries of the interval or by giving directly these values. The selected sites are then represented on the map in red. A selection by 'points' or 'polygon' on the map results in the drawing of the density of the corresponding sub-distribution on the density plot. Finally, the user can modify the bandwith parameter with a cursor in the tk window (parameter α). α is the smoothing parameter for the kernel smooth : it represents the mean percentage of sample points involved in the local averaging (example : $\alpha = 20$ means that on average, $n \times 0.2$ points are in any interval of length 2h where h is the usual bandwidth).

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

Venables, W. N. and Ripley, B. D. (2002) *Modern Applied Statistics with S*. New York: Springer.

Wand M.P. et Jones M.C. (1995), *Kernel Smoothing*, Chapman \& Hall.

See Also

`histomap`, `histobarmap`, `scattermap`, `densitymap`

Examples

```
#########
# data auckland
data(auckland)

# creation of a Spatial object
auckland.sp = SpatialPoints(cbind(auckland$Easting,auckland$Northing))
# ... and then by integrating other variables to create SpatialPointsDataFrame
```

```
auckland.spdf = SpatialPointsDataFrame(auckland.sp, auckland)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
contours.auckland<-polylist2list(auckpolys)

dbledensitymap(auckland.spdf, c("Deaths.1977.85","Under.5.1981"),carte=contours.auckland,
xlab=c("Deaths.1977.85","Under.5.1981"),
criteria=(auckland$Deaths.1977.85>mean(auckland$Deaths.1977.85)))


######
# data eire
require("maptools")
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))

dbledensitymap(eire,c("A","towns"),kernel="normal",
xlab=c("Individuals rate of blood type A",
"Surface urbaine"),identify=TRUE)
```

`dblehistomap` *Double Interactive Histogram and map*

Description

The function `dblehistomap` draws two histograms of the given variables `names.var[1]` and `names.var[2]` and a map with sites of coordinates `coordinates(sp.obj)`. Each site is associated to a value of `names.var[1]` and `names.var[2]` and there is interactivity between the two windows created.

Usage

```
dblehistomap(sp.obj, names.var, nbcol=c(10,10),
type = c("count","percent", "density"), names.attr=names(sp.obj), criteria=NULL,
carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col=c("grey","lightblue3"),
xlab=c("",""), ylab=c("count","count"), axes=FALSE, lablong="", lablat="")
```

Arguments

`sp.obj`	object of class extending Spatial-class
`names.var`	a vector of 2 characters; attribute name or column number in attribute table
`nbcol`	a vector of integer indicating number of cells for histogram 1 and histogram 2 (10 for each by default)
`type`	Character string indicating type of histogram to be drawn. "percent" and "count" give relative frequency and frequency histograms, "density" produces a density scale histogram.

names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	a vector of character indicating colors for the bars on the histogram 1 and histogram 2
xlab	a vector of character containing titles for the two graphics x-axis
ylab	a vector of character containing titles for the two graphics y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

The selection of sites by 'points' or 'polygons' on the map results in the drawing of the red histograms of the subdistributions corresponding to this subset of sites.

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

dblehistomap, histobarmap, scattermap, densitymap

Examples

```
######
# data on price indices of real estate in France
data(immob)
row.names(immob)<-immob$Nom

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))
# ... and then by integrating other variables to create SpatialPointsDataFrame
immob.spdf = SpatialPointsDataFrame(immob.sp, immob)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
require("maptools")
midiP <- readShapePoly(system.file("shapes/region.shp", package="GeoXp")[1])
cont_midiP<-spdf2list(midiP[-c(22,23),])$poly

# A basic call of dblehistomap function
dblehistomap(immob.spdf,c("prix.vente","prix.location"),
carte= cont_midiP, identify=TRUE, cex.lab=0.6)

###
# data colombus
x <- readShapePoly(system.file("shapes/columbus.shp", package="maptools")[1])

# example of use with many options
dblehistomap(x,c("HOVAL","CRIME"), nbcol=c(5,10),type="percent",
xlab=c("hoval","crime"),identify=TRUE, cex.lab=0.7, ylab=c("percent","percent"),
col=c("pink","orange"),pch=14,axes=TRUE)
```

`densitymap` *Kernel density estimates and map*

Description

The function `densitymap` draws kernel density estimates of the variable `name.var` with bkde and a map with sites of coordinate `coordinates(sp.obj)`. Each site is associated to a value of `name.var` and there is interactivity between the two windows.

Usage

```
densitymap(sp.obj, name.var, kernel='triweight',
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8, pch=16,
col="lightblue3", xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
name.var	a character; attribute name or column number in attribute table
kernel	Smoothing kernel (see help(bkde) for list of options)
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the histogram
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

The user can choose an interval on the density curve by mouse clicking on the graph on the extremities of interval or by specifying directly values. The sites selected by an interval are then represented on the map in red. The selection of sites on the map by 'points' or 'polygon' results in the drawing of the kernel densities of the subdistributions corresponding to this subset of sites. Finally, the user can modify the bandwith parameter with a cursor in the Tk window (parameter α). α is the smoothing parameter for the kernel smooth : it represents the mean percentage of sample points involved in the local averaging (example : $\alpha = 20$ means that on average, $n \times 0.2$ points are in any interval of length 2h where h is the usual bandwidth).

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Venables, W. N. and Ripley, B. D. (2002) *Modern Applied Statistics with S*. New York: Springer.

Wand M.P. et Jones M.C. (1995), *Kernel Smoothing*, Chapman \& Hall.

See Also

histomap, histobarmap, scattermap, densitymap

Examples

```
######
# data oldcol
require("maptools")
example(columbus)

# columbus is included in the Spatial-Class object
# a very simple use of histomap :
densitymap(columbus,"CRIME")

######
# data on price indices of real estate in France
data(immob)
row.names(immob)<-immob$Nom

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))
# ... and then by integrating other variables to create SpatialPointsDataFrame
immob.spdf = SpatialPointsDataFrame(immob.sp, immob)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
midiP <- readShapePoly(system.file("shapes/region.shp", package="GeoXp")[1])
cont_midiP<-spdf2list(midiP[-c(22,23),])$poly

# A basic call of densitymap function
densitymap(immob.spdf,"prix.vente", carte= cont_midiP, identify=TRUE,
xlab="housing price by square meter", cex.lab=0.6)
```

driftmap *Interactive driftplot and map*

Description

The function driftmap() creates two devices : a device with the map of coord coordinates(sp.obj) which permits to make selection of sites and a device divided into 2 rows and 2 columns which contains : (cell 1) the selected sites divided into m rows and q columns (m and q are selected with the tk window), (cell 2) a scatter plot with coordinates(sp.obj)[,2] in x-axis and the mean and median of name.var calculated for the m rows in y-axis, (cell 3) a scatter plot with the mean and median of name.var calculated for the q columns in x-axis and coordinates(sp.obj)[,1] in y-axis and (cell 4) a legend indicating the direction of the North, the variable used, etc.

Usage

```
driftmap(sp.obj, name.var, interpol=TRUE, nuage=TRUE, lty=1:2, cex=0.7,
names.attr=names(sp.obj), carte=NULL, identify=FALSE, cex.lab=0.8, pch=rep(16,3),
col=c("lightblue3", "black", "red"), xlab="", axes=FALSE)
```

Arguments

sp.obj	object of class extending Spatial-class
name.var	a character; attribute name or column number in attribute table
interpol	if TRUE, the mean and median calculated are linearly interpoled
nuage	if TRUE, the values taken by var are also represented on right plot and on the left plot
lty	the line type for mean and median in the case of interpol=TRUE
cex	the amount by which plotting symbols on the cell 1 and in the case of nuage=TRUE cell 2 and cell 3
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	c(16,16,16) by default, list of symbols for (1) the values of var on the left and on the right plot (2) the mean points, (3) the median points
col	c("lightblue3", "black", "red") by default, list of colors for (1) the values of var on the left and on the right plot (2) the mean points, (3) the median points
xlab	name of var printed with the legend plot
axes	a boolean with TRUE for drawing axes on the map

Details

Possibility to change the number of cells in the grid with the tk window, to interpolate the means and medians calculated (by default), to work on a rotated map. At the begining, all sites have been selected to the map : users have to deselect sites that they have choosen.

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

angleplotmap,variocloudmap,rotation

Examples

```
######
# data on price indices of real estate in France
data(immob)
row.names(immob)<-immob$Nom

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))
# ... and then by integrating other variables to create SpatialPointsDataFrame
immob.spdf = SpatialPointsDataFrame(immob.sp, immob)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
require("maptools")
midiP <- readShapePoly(system.file("shapes/region.shp", package="GeoXp")[1])
cont_midiP<-spdf2list(midiP[-c(22,23),])$poly

# a simple use of driftmap
driftmap(immob.spdf,"prix.vente", carte= cont_midiP)

# ... with options
driftmap(immob.spdf,"prix.vente", carte= cont_midiP,
interpol=FALSE, nuage=TRUE, lty=3:4,
```

```
identify=TRUE, cex.lab=0.3, xlab="Price of sell", axes=TRUE)

######
# data eire
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))

# a basic usage ...
driftmap(eire,"pale",identify=TRUE,nuage=TRUE)
```

---

genpca *Generalized Principal Component Analysis (PCA)*

Description

The function genpca computes a generalized Principal Component Analysis (PCA). It calculates the principal components, the coordinates of the variables and in these principals components axes and the inertia of these principal components.

Usage

```
genpca(data, w=rep(1/nrow(data),length=nrow(data)),
m=diag(ncol(data)), center=NULL, reduc=TRUE)
```

Arguments

data	matrix $n \times p$
w	vector of size n of weight (by default : $weight = t(1/n, ..., 1/n)$)
m	matrix $p \times p$ (by default : metric=Identity matrix)
center	boolean. if TRUE, centered PCA (by default : center=TRUE)
reduc	boolean. if TRUE, reduced PCA (by default : reduce=TRUE)

Details

Let

$$W = diag(w)$$

$$x = data = (x'_1, ..., x'_n)'$$

with

$$x_i = (x_i^1, ..., x_i^p)$$

Let

$$1_n = (1, ..., 1)'$$

with n rows and :

$$1_p = (1, ..., 1)'$$

with p rows. Normalization of weight :

$$w_i = \frac{w_i}{\sum_i w_i}$$

Vector of means :

$$\bar{x} = (\bar{x^1}, ..., \bar{x^p})'$$

with:

$$\bar{x^j} = \sum_i w_i x_i^j$$

If center=True,

$$x_c = x - 1_n \bar{x}'$$

Standart deviation :

$$(\sigma^j)^2 = \sum_i w_i (x_i^j)^2 - (\bar{x^j})^2$$

$$\Sigma = diag((\sigma^1)^2, ..., (\sigma^p)^2)'$$

If reduc=True :

$$x_{cr} = x_c \times \Sigma^{-1/2}$$

Variance-Covariance matrix:

$$C = x'_{cr} W x_{cr}$$

Cholesky decomposition : $M = LL'$ where M=m
Let

$$C_l = LCL'$$

Let U and D as :

$$C_l U = UD$$

with $D = diag(\lambda_1, ..., \lambda_p)$
Let

$$V = L'U$$

Then :
Coordinates of individuals in the principals components basis :

$$CC = x_{cr} V$$

Coordinates of variables in principals components :

$$VC = CVD^{-1/2}$$

Inertia :

$$I = D1_p$$

Value

Returns 'inertia' vector of size p with percent of inertia of each component (corresponding to I), 'casecoord' matrix $n \times p$ (corresponding to matrix CC), 'varcoord' matrix $p \times n$ (corresponding to matrix VC0).

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Caussinus H., Fekri M., Hakam S., Ruiz-Gazen A. (2003) , *A monitoring display of Multivariate Outliers*, Computational Statistics and Data Analysis, vol. 44, 1-2, 237-252.

See Also

clustermap,pcamap

`gini` *Calculates a Gini Index*

Description

The function `gini()` calculates the Gini Index associated to the variable `var`.

Usage

```
gini(var)
```

Arguments

`var`	a vector of numerical values of size n

Details

Let x_k, k=1,...,K be the distinct values taken by `var`. For each site, Gini.r returns two pairs of frequencies. The pair (f,g) where f represents

$$f_k = \frac{1}{n} \sum_i 1(Var_i = x_k)$$

(n is the length of `var`) and g represents

$$g_k = \frac{x_k}{\bar{x}} f_k$$

The pair (F,G) represents the corresponding cumulative frequencies.
The Gini Index is calculated as :

$$I_G = \frac{1}{2\bar{x}} \sum_{i=1}^{K} \sum_{j=1}^{K} |x_i - x_j|$$

Value

(f, F, g, G, gini) where f, F, g and G are vectors of size K and gini a numeric value.

Note

This function is used in ginimap.R but it is not an interactive function.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

ginimap

`ginimap` *Lorentz curve and map*

Description

The function `ginimap()` computes a Lorentz curve from `name.var` and calculates the Gini Index associated to `name.var`.

Usage

```
ginimap(sp.obj, name.var, names.attr=names(sp.obj), criteria=NULL,
carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3",
xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

`sp.obj`	object of class extending Spatial-class
`name.var`	a character; attribute name or column number in attribute table
`names.attr`	names to use in panel (if different from the names of variable used in sp.obj)
`criteria`	a vector of boolean of size the number of Spatial units, which permit to represent preselected sites with a cross, using the tcltk window
`carte`	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
`identify`	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
`cex.lab`	character size of label

pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the histogram
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

Users have the possibility to choose a threshold by mouse clicking on the Lorentz curve or by specifying it in the menu. The corresponding pair (F,G) and the value of `name.var` are then printed on the graph and the sites with a value of `name.var` lower or equal to the threshold are then selected on the map.

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Note

The Gini Index is given in the tcltk window (see function `gini` for the formula used to calculate it).

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

`gini`

Examples

```
######
# data eire
require("maptools")
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))

# a basic usage ...
ginimap(eire,"INCOME")
```

```
# ... with options
ginimap(eire,"INCOME",criteria=(eire$pale==1),
identify=TRUE, pch=5, col="orange",
axes=TRUE, lablong="X", lablat="Y")
```

---

graphique *Drawing a graphic*

Description

The function 'graphique' draws a specific graphic. Possibility to draw one of these graphics : Histogram, Barplot, Boxplot, Polyboxplot, Scatterplot, Densityplot, Neighbourplot, Lorentz, Moran, Angleplot, Variocloud, Cluster and PCA (graphics of individuals and variables). This function is called in most of the functions of GeoXp (this is not an interactive function).

Usage

```
graphique(var1, var2, var3, obs, num, graph = "", couleurs = "",
    symbol = 16, labvar = "", nbcol = 10, alpha1, W,
    Xpoly, Ypoly, F, G, opt1 = 1, opt2 = 1, quantiles = 0,
    labmod = "", direct, inertie, label = 0, kernel, obsq, locmoran = FALSE,
    bin = NULL, cex.lab=1, buble=FALSE, cbuble=NULL, legmap=NULL,
    legends=list(FALSE,FALSE), xlim, ylim)
```

Arguments

var1	1st variable of size n
var2	2nd variable of size n
var3	3rd variable of size n (used for variocloudmap)
obs	a vector of boolean of size n with sites selected
num	number of windows which must be activated (3 ou 4)
graph	name of graphic which must be drawn : Histogram, Barplot, Boxplot, Polyboxplot, Scatterplot, Densityplot1, Densityplot2, Neighbourplot, Lorentz, Moran, Quadrant, Angleplot, Variocloud, Cluster, Acp1, Acp2
couleurs	Possibilty to change colors on the graphic
symbol	choice of representation of selected sites
labvar	name(s) of variable(s) studied
nbcol	number of cells if the graphic choosen is the histogram (10 by default)
alpha1	regression smoothing paramater
W	Spatial weight matrix
Xpoly	x-coordinates of the vertices of selected polygon
Ypoly	y-coordinates of the vertices of selected polygon
F	Used for Ginimap

G	Used for Ginimap
opt1	Option for adding a curve (regression line or conditionnal quantile depending on the function)
opt2	Option for drawing robust empirical variogram
quantiles	vector which contains the values of α for conditionnal quantile
labmod	names of factor if the graphic choosed is a barplot
direct	Used for PCA
inertie	Used for PCA
label	Name of sites
kernel	Name of the kernel choosed in densitymap
obsq	Used for clustermap and barmap
locmoran	Print local moran for each site
bin	The bins chosen to calculate empirical variogram
cex.lab	character size of label
buble	For Local Moran plot only : a boolean with TRUE for drawing bubbles, FALSE otherwise
cbuble	For Local Moran plot only : vector of size n with size of each site depending on variable with which bubbles are constructed
legmap	For Local Moran plot only : a list of (numeric,numeric,numeric,numeric,numeric,numeric,character) with the sizes and the corresponding values of the 3 bubbles represented in the legend and the variable name of variable choosed
legends	For Local Moran plot only : a list of c(boolean,boolean,c(numeric,numeric),c(numeric,numeric)) with TRUE for drawing legends of bubbles (1st argument) or factors (2nd argument) and the coordinates of the location of the upper left corner of the legend box
xlim	the x limits of the plot
ylim	the y limits of the plot

Details

This function is called by any function which draws a graphic. A lot of options are considered because of the large number of graphics proposed

Value

No values, only drawing of a graphic

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

histnbmap *Interactive histogram of the distances between two neighbors of a nb object and map*

Description

The function histnbmap() draws the histogram of the distances between two neighbors for a neighbourhood structure given by a nb object and calculated by nbdists function (see spdep package), and links the graphic with a map.

Usage

```
histnbmap(sp.obj, nb.obj, longlat = NULL, nbcol=10,
type = c("count","percent", "density"), sup=FALSE, criteria=NULL, carte=NULL,
identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3", xlab="", ylab="count",
axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
nb.obj	object of class nb
longlat	TRUE if point coordinates are longitude-latitude decimal degrees, in which case distances are measured in kilometers; if coords is a SpatialPoints object, the value is taken from the object itself
nbcol	number of cells for histogram (10 by default)
type	Character string indicating type of histogram to be drawn. "percent" and "count" give relative frequency and frequency histograms, "density" produces a density scale histogram.
sup	if TRUE, it keeps only the distance of the neighbor the farest
criteria	a vector of boolean of size the number of Spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the barplot
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

For a selected site j on the map, are represented on the map its neighbours. For a selected bar on the graph, the corresponding sites are represented on the map with a link which means that two sites are neighbours.

Value

No value returned.

Note

When user select sites on the graph or on the map, he cannot add a selection by using the other graphic.

Author(s)

Aragon Y., Thomas-Agnan C., Ruiz-Gazen A., Laurent T.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

moranplotmap,makeneighborsw,normw,nonormmoran

Examples

```
##
# data columbus
require("maptools")
example(columbus)

# a simple use of histnbmap
histnbmap(columbus, col.gal.nb, criteria=(columbus$CP==1),
xlab="distance of the neighbor the farest")

##
# data meuse
data(meuse)

# meuse is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
meuse.sp = SpatialPoints(cbind(meuse$x,meuse$y))
```

```
# ... and then by integrating other variables to create SpatialPointsDataFrame
meuse.spdf = SpatialPointsDataFrame(meuse.sp, meuse)

# meuse.riv is used for contour plot
data(meuse.riv)

# creation of a spatial weight matrix (class nb) based
# on the Delaunay triangulation
meuse.nb <- tri2nb(coordinates(meuse.sp))

# a example with some optionswhich shows the limit of
# this kind of spatial weight matrix
histnbmap(meuse.spdf, meuse.nb, sup=TRUE, nbcol=7,
carte=meuse.riv[c(21:65,110:153),])
```

`histobarmap` *Histogram, barplot and map*

Description

The function `histobarmap()` draws a bar plot (vertical bar) of the given variable `names.var[1]`, a histogram of the given variable `names.var[2]` and a map with sites of coordinates `coordinates(sp.obj)`.

Usage

```
histobarmap(sp.obj, names.var, nbcol = 10, type = "count",
names.arg = "", names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE,
cex.lab=0.8, pch=16, col="lightblue3", xlab=c("barplot","histogram"), ylab=rep("count",2),
axes=FALSE, lablong="", lablat="")
```

Arguments

`sp.obj`	object of class extending Spatial-class
`names.var`	a vector of 2 characters; first character corresponds to the name of a factor and second character corresponds to a numeric value
`nbcol`	number of cells for histogram (10 by default)
`type`	Character string indicating type of histogram/barplot to be drawn. "percent" and "count" give relative frequency and frequency histogram/barplot.
`names.arg`	a vector of level names (for factor)
`names.attr`	names to use in panel (if different from the names of variable used in sp.obj)
`criteria`	a vector of boolean of size the number os spatial units, which permit to represent preselected sites with a cross, using the tcltk window
`carte`	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon

identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	a vector of symbol which must be equal to the number of group else all sites are printed in pch[1]
col	a vector of colors which must be equal to the number of group else all sites and all box are printed in col[1]
xlab	a vector of names for x-title of the barplot and histogram
ylab	a vector of names for y-title of the barplot and histogram
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

Each site is associated to a factor of `names.var[1]` and to a value of `names.var[2]`. There is interactivity between the three windows created: the sites selected by a bar on the bar plot or on the histogram are represented on the map in red and the value and factor of sites selected on the map are represented in red on the bar plot and on the histogram.

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

`dblehistomap`, `histobarmap`, `scattermap`, `dbledensitymap`

Examples

```
###
# Data Colombus
require("maptools")
example(columbus)

# an example of use
histobarmap(columbus,c("CP","HOVAL"),nbcol=8, type="percent",
names.arg=c("A","B"), xlab=c("CP","Hoval"), ylab=rep("percent",2))

######
# data eire
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))

# example of use
histobarmap(eire, c("pale","A"),names.arg=c("Ouside Pale","Pale"),
xlab=c("Appartenance to the region of Pale","Average number of people with blood A"),
col=colors()[101:102],identify=TRUE)
```

`histomap` *Interactive Histogram and map*

Description

The function `histomap()` draws a histogram of a given variable `name.var` and a map with sites of coordinates `coordinates(sp.obj)`. Each site is associated to a value of `name.var` and there is interactivity between the two windows.

Usage

```
histomap(sp.obj, name.var, nbcol=10, type = c("count","percent", "density"),
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3", xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

`sp.obj`	object of class extending Spatial-class
`name.var`	a character; attribute name or column number in attribute table
`nbcol`	number of cells for histogram (10 by default)
`type`	Character string indicating type of histogram to be drawn. "percent" and "count" give relative frequency and frequency histograms, "density" produces a density scale histogram.
`names.attr`	names to use in panel (if different from the names of variable used in sp.obj)
`criteria`	a vector of size n of boolean which permit to represent preselected sites with a cross, using the tcltk window

carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the histogram
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

Sites selected by a bar on the histogram are represented on the map in red and the values of sites selected on the map by 'points' or 'polygon' are represented in red as a sub-histogram on the histogram.

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

`histomap`, `histobarmap`, `scattermap`, `densitymap`

Examples

```
######
# data oldcol
require("maptools")
example(columbus)

# columbus is included in the Spatial-Class object
# a very simple use of histomap :
histomap(columbus,"CRIME")

######
# data on price indices of real estate in France
data(immob)

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))
# ... and then by integrating other variables to create SpatialPointsDataFrame
immob.spdf = SpatialPointsDataFrame(immob.sp, immob)
# we just give names to the spatial units...
row.names(immob.spdf)<-immob$Nom
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
midiP <- readShapePoly(system.file("shapes/region.shp", package="GeoXp")[1])
cont_midiP<-spdf2list(midiP[-c(22,23),])$poly

# A basic call of histomap function
histomap(immob.spdf,"prix.vente", carte= cont_midiP, identify=TRUE, cex.lab=0.6)

# ... with all options
histomap(immob.spdf,7, nbcol=15, type = "percent",
names.attr=names(immob), criteria=immob$rentabilite>5, carte=cont_midiP,
identify=TRUE, cex.lab=0.5, pch=12, col="pink",
xlab="variation price", ylab="percent", axes=TRUE, lablong="x",
lablat="y")
```

---

immob *Some price indices of real estate from biggest cities in France*

Description

This data frame contains price indices of real estate from biggest cities in France in 2008.

Usage

```
data(immob)
```

Format

A data frame with 94 observations on the following 10 variables.

`Nom` Name of the city

`Code.INSEE` Code Insee of the city

`Code.region` Code of the 'region' area of the city

`longitude` A vector x of size n

`latitude` A vector y of size n

`prix.vente` Average selling price at square metres

`variation.vente` Rates of change in the average selling price for a quarter year

`prix.location` Average price of rental square metres

`variation.location` Rates of change in the average price of rent for a quarter

`rentabilite` Rentability

Source

Prepared by T. Laurent.

References

http://www.fnaim.fr/

Examples

```
data(immob)
```

`makeneighborsw` *Spatial weight matrix*

Description

The function `makeneighborsw()` create a spatial weight matrix based on a given number of nearest neighbors (option "neighbor" by default), based on a threshold distance (option method="distance") or both these 2 methods.

Usage

```
makeneighborsw(coords,method="neighbor",m=1,d,cum=TRUE)
```

Arguments

coords	a matrix of spatial coordinates
method	"neighbor" by default, "distance" or "both"
m	number of nearest neighbors
d	threshold point
cum	if cum=TRUE, W is the sum of spatial weight matrix based on k nearest neighbours (for $k \leq m$; if FALSE W is the spatial weight matrix based only on m^{th} nearest neighbours

Details

In the case of method="neighbor", for each site, we order the other sites by their distance from this site. If cum=TRUE, for i, if j is among the m^{th} nearest sites, then :

$$W_{ij} = 1$$

else

$$W_{ij} = 0$$

If cum=FALSE, for

$$s_i$$

, if

$$s_j$$

is the m^{th} nearest site, then :

$$W_{ij} = 1$$

else

$$W_{ij} = 0$$

In case of ties, the nearest neighbour is randomly chosen.

In the case of method="distance", if site i is seperated from j by a distance lower or equal to a given threshold :

$$W_{ij} = 1$$

else

$$W_{ij} = 0$$

In the case of method="both" W must verify the two first conditions.

Value

A spatial weight matrix of size $n \times n$

Note

This function is not optimised for large dataset. User could find similar functions in the package spdep (dnearneigh and knearneigh). However, these functions don't offer the possibility to use the two criteria in the same time. Moreover, an inconvenient of makeneighborsw is that the result is included in a matrix object whereas most of functions of GeoXp use the nb structure for spatial weight matrix. An issue is to use the mat2listw function and then selecting the nb part, like the in the examples.

Author(s)

Aragon Y., Thomas-Agnan C., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

moranplotmap,normw

Examples

```
##
# data auckland
data(auckland)
coords <- cbind(auckland$Easting[1:10],auckland$Northing[1:10])

# matrix based on 5 nearest neighbors
W<-makeneighborsw(coords,method="neighbor",m=3)

# matrix based on a threshold distance
W1<-makeneighborsw(coords,method="distance",d=20)

# matrix based on the two methods
W2<-makeneighborsw(coords,method="both",m=3,d=20)

# representation of the 3 spatial weight matrices
op<-par(mfrow=c(2,2))
plot(mat2listw(W),coords,col="lightblue1",main="neighbor")
plot(mat2listw(W1),coords,col="lightblue2",main="distance")
plot(mat2listw(W2),coords,col="lightblue3",main="both")
par(op)
```

misolationmap *Interactive multivariate isolation plot and map*

Description

The function misolationmap draws a scatterplot with the pairwise Mahalanobis distances calculated using variables names.var between the observations and their neighbors on the y-axis and the "degree of isolation" of the observations on the x-axis and a map

Usage

```
misolationmap(sp.obj, nb.obj, names.var, propneighb=0.4,chisqqu=0.975,
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3", xlab="degree of isolation",
ylab="Pairwise Mahalanobis distances", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
nb.obj	object of class nb
names.var	a vector of character; attribute names or column numbers in attribute table
propneighb	proportion of neighbors included in ellipsoid
chisqqu	value of alpha for the definition of global outliers
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of size n of boolean which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	color of the points on the cloud map
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

The pairwise Mahalanobis distances are calculated using the robust Minimum Covariance Determinant (MCD) estimator associated with 75% of observations (function `covMcd` in the robustbase package) calculated on the variables `names.var`. For each observation, the degree of isolation is a chi-square quantile of the conditional distribution of the pairwise Mahalanobis distances associated with the ellipsoid containing the proportion `propneighb` of neighbors. The parameter `propneighb` gives the proportion of neighbors that is expected to be quite similar to the observation in order to conclude that the observation is not a local outlier. Under independence and normality conditions, the user can expect a degree of isolation close by the parameter `propneighb` (vertical line on the scatterplot). An observation with a high degree of isolation is suspected to be a local outlier. Users have also the possibility to plot bubbles on the map which size depends on the robust Mahalanobis distance of each observation to the center of the distribution (function `arw` in the package `mvoutlier`).

Value

In the case where user click on `save results` button, a matrix of integer is created as a global variable in `last.select` object. It corresponds to the numbers of spatial unit corresponding to couple of sites selected just before leaving the Tk window.

Author(s)

Fizmoser P., Thomas-Agnan C., Ruiz-Gazen A., Laurent T.,

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

`mvariocloudmap`

Examples

```
## data radarImage
require("robustbase")
data(radarImage)

# creation of a SpatialClass object
radarImage.sp <- SpatialPoints(radarImage[1300:1573,c("X.coord","Y.coord")])
radarImage.spdf <- SpatialPointsDataFrame(radarImage.sp, radarImage[1300:1573,])

# creation of a spatial weight matrix nb
radarImage.nb <- dnearneigh(radarImage.sp, 0,1.5 )

# example of use of misolationmap
# The statistics are calculated by taking into account variables
# Ag,As,Bi,Cd,Co,Cu,Ni
misolationmap(radarImage.spdf,radarImage.nb,names.var=c("Band.1","Band.2","Band.3"),
```

```
propneighb=0.30,chisqqu=0.95, identify=TRUE, cex.lab=0.5)
```

`moranplotmap` *Moran scatterplot and map*

Description

The function `moranplotmap()` draws a moran plot, used to detect spatial autocorrelation in the variable var. On the x-axis, is represented $x - \bar{x}$ and on the y-axis $W(x - \bar{x})$, where W is the spatial weight matrix. It also calcultes Moran's I statistic (see `nonnormoran`) and give a p-value associated to the autocorrelation test (gaussian version and permutation version).

Usage

```
moranplotmap(sp.obj, name.var, listw.obj, flower=FALSE, locmoran=FALSE,
names.arg=c("H.-H.","L.-H.","L.-L.","H.-L."), names.attr=names(sp.obj), criteria=NULL,
carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3",
xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

`sp.obj`	object of class extending Spatial-class
`name.var`	a character; attribute name or column number in attribute table
`listw.obj`	object of class listw
`flower`	if TRUE, link neighbouring sites
`locmoran`	if TRUE, print local Moran's I statistic on the Moran plot
`names.arg`	names of the quadrant of the Moran plot
`names.attr`	names to use in panel (if different from the names of variable used in sp.obj)
`criteria`	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
`carte`	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
`identify`	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
`cex.lab`	character size of label
`pch`	16 by default, symbol for selected points
`col`	"lightblue3" by default, color of bars on the histogram
`xlab`	a title for the graphic x-axis
`ylab`	a title for the graphic y-axis
`axes`	a boolean with TRUE for drawing axes on the map
`lablong`	name of the x-axis that will be printed on the map
`lablat`	name of the y-axis that will be printed on the map

Details

For the permutation test, for each drawing the values of the variable `var` are randomly assigned to the sites. We then calculate Moran'I statistic associated to each drawing and we give the frequency of drawings when Moran'I statistic is lower or equal to the observed Moran'I statistic. Moreover, the function gives the opportunity to link neighbouring sites and gives Local Moran's I statistic. For a site i:

$$I_i = (x_i - \bar{x}) \sum_j W_{ij}(x_j - \bar{x})$$

with j not equal to i.

Value

In the case where user click on `save results` button, a list is created as a global variable in `last.select` object. \$obs, a vector of integer, corresponds to the number of spatial units selected just before leaving the Tk window, \$MORAN, a numeric, corresponds to the value of the Moran'I statistic.

Note

In the case of the spatial weigth matrix is not normalized, the Moran'I statistic is not equal to β used in regression line for model $W(X - \bar{X}) = \beta(X - \bar{X}) + u$. That is why the regression line is only drawn in the case of W normalized.

Author(s)

Aragon Y., Thomas-Agnan C., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

Jim Lesage, "Spatial Econometrics Toolbox", http://www.spatial-econometrics.com/

See Also

neighbourmap,makeneighborsw,normw,nonormmoran

Examples

```
##
# data baltimore
data(baltimore)
```

```
# SpatialPoints
baltimore.sp <- SpatialPoints(cbind(baltimore$X,baltimore$Y))
# SpatialPointsDataFrame
baltimore.spdf<-SpatialPointsDataFrame(baltimore.sp,baltimore)

# Spatial Weight Matrix
W.nb <- knn2nb(knearneigh(baltimore.sp, k=4))
# We choose a row standardized spatial weight matrix :
W.listw <- nb2listw(W.nb,style="W")


# moranplotmap with some options
moranplotmap(baltimore.spdf, "PRICE", W.listw ,
flower=TRUE, locmoran=TRUE,criteria=(baltimore.spdf$AC==1),
identify=TRUE)

# comparison with the moran.test function
moran.test(baltimore.spdf$PRICE,W.listw)

##
# data columbus
require("maptools")
example(columbus)

# use of moranplotmap with spatial weight matrix col.gal.nb :
# 1. row-standardized
moranplotmap(columbus,"HOVAL",nb2listw(col.gal.nb,style="W"))

# 2. basic binary
moranplotmap(columbus,"HOVAL",nb2listw(col.gal.nb,style="B"))

# 3. globally standardized
moranplotmap(columbus,"HOVAL",nb2listw(col.gal.nb,style="C"))
```

`mp.school` *Midi-pyrennees school*

Description

This data frame contains some information about schools in Midi-Pyrenees region. The school is the spatial unit level.

Usage

```
data(mp.school)
```

Format

A data frame with 226 observations on the following 13 variables.

`longitude` x-coordinate of the pseudo-canton

`latitude` y-coordinate of the pseudo-canton

`name.city` Name of the city

`index.rurality` A factor with levels of rurality

`Nb.students` Number of students

`Occupancy.rate` Rate of occupancy

`Cost.per.student` Average cast per student

`Nb.students.per.class` Average number of students per class

`Freq.certifies` The frequency of certifies teachers

`Freq.agreges` The frequency of agreges teachers

`Freq.rep.stud` The frequency of students who repeated a class

`Nb.specialties` the number of specialities offered to students in the school

`Teachers.age` The mean age of the teachers in the school

Note

The variables `Occupancy.rate`, `Cost.per.student` and `Nb.students.per.class` have been permuted because of the confidentiality of this data set.

Source

Prepared by T. Laurent.

Examples

```
data(mp.school)
```

---

mp.school.ps *Midi-pyrennees school agreggated to the pseudo-canton levels*

Description

This data frame contains some information about schools agreggated to the pseudo-canton levels in Midi-Pyrenees region. The pseudo-canton is the spatial unit level.

Usage

```
data(mp.school.ps)
```

Format

A data frame with 155 observations on the following 7 variables.

`longitude` x-coordinate of the pseudo-canton

`latitude` y-coordinate of the pseudo-canton

`name.canton` Name of the pseudo-canton

`rurality.rate` Ratio of the number of rural communes in the pseudo-canton to the number of communes

`Nb.students.per.class` Average number of students per class

`Cost.per.student` Average cast per student

`Code` The mean age of the teachers in the school

Note

The variables `Cost.per.student` and `Nb.students.per.class` have been permuted because of the confidentiality of this data set.

Source

Prepared by T. Laurent.

Examples

```
data(mp.school.ps)
```

`mvariocloudmap` *Interactive multivariate variocloud and map*

Description

The function `mvariocloudmap()` draws a scatterplot of pairwise Mahalanobis distances and spatial distances with a map. It is a multivariate version of the variocloud. The number of couples of sites plotted can be reduced by considering couples above a quantile regression curve.

Usage

```
mvariocloudmap(sp.obj, nb.obj, names.var, quantiles=TRUE,
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3", xlab="Pairwise spatial distances",
ylab="Pairwise Mahalanobis distances", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
nb.obj	object of class nb
names.var	a vector of character; attribute names or column numbers in attribute table
quantiles	a boolean to represent the Additive Quantile Regression Smoothing
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	color of the points on the cloud map
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

The pairwise Mahalanobis distances are calculated using the Minimum Covariance Determinant (MCD) estimator associated with 75% of observations (function `covMcd` in the `robustbase` package). Users have the possibility to select some couples of sites on the scatterplot that are also highlightened on the map. Selection of observations on the map is also possible and leads to the selection of all the couples which contain the selected observations on the scatterplot.

Value

In the case where user click on `save results` button, a matrix of integer is created as a global variable in `last.select` object. It corresponds to the numbers of spatial unit corresponding to couple of sites selected just before leaving the Tk window.

Author(s)

Fizmoser P., Thomas-Agnan C., Ruiz-Gazen A., Laurent T.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

misolationmap

Examples

```
## data meuse
data(meuse)

# transformation of explanatory variables
meuse[,3:7]<-log(1+meuse[,3:7])

# creation of a Spatial Points object
meuse.sp<-SpatialPoints(cbind(meuse$x,meuse$y))

# creation of a SpatialPointsDataFrame
meuse.spdf<-SpatialPointsDataFrame(meuse.sp,meuse)

# for the spatial contours
data(meuse.riv)

# Spatial Weight matrix based on the 7th nearest neighbours
meuse.knn <- knearneigh(meuse.sp, k=7)
meuse.nb <- knn2nb(meuse.knn)

# example of use of mvariocloudmap. The statistic are calculated by taking
# into account variables cadmium,copper,lead,zinc,elev
mvariocloudmap(meuse.spdf,meuse.nb,c("cadmium","copper","lead","zinc","elev"),
quantiles=0.95, carte=meuse.riv[-c(1:20,73:98,156:176),],identify=TRUE,
criteria=(meuse.spdf$lime==1))
```

---

neighbourmap *Neighbour plot and map*

Description

The function neighbourmap() identifies spatial outliers by comparing a variable value for a particular site with these of its neighbouring sites. It draws a scatterplot of the values of the variable at neighbouring sites for a neighbourhood structure given by a binary weight matrix W and links this scatterplot with a map.

Usage

```
neighbourmap(sp.obj, name.var, nb.obj, lin.reg=TRUE,
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3", xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
name.var	a character; attribute name or column number in attribute table
nb.obj	object of class nb
lin.reg	If TRUE, drawing the linear curve y=x
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the histogram
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

For a selected site j on the map, are represented on the map its neighbors, and on the graph, on the x-axis the value of `var` for this site, and in y-axis, the values of `var` for the neighbouring sites of j. For a selected point on the graph, the corresponding pair of sites is represented on the map with a link.

Value

In the case where user click on `save results` button, a matrix of integer is created as a global variable in `last.select` object. It corresponds to the numbers of spatial unit corresponding to couple of sites selected just before leaving the Tk window.

Note

When user selects sites on the graph or on the map, he cannot add a selection by using the other graphic.

Author(s)

Aragon Y., Thomas-Agnan C., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

moranplotmap,makeneighborsw,normw,nonormmoran

Examples

```
###
# columbus
require("maptools")
example(columbus)

# example of use of neighbourmap
neighbourmap(columbus, "CRIME", col.gal.nb,
criteria=(columbus@data$CRIME>mean(columbus@data$CRIME)))

###
# data immob
data(immob)

# change names of individuals
row.names(immob) <- immob$Nom

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))
# ... and then by integrating other variables to create SpatialPointsDataFrame
immob.spdf = SpatialPointsDataFrame(immob.sp, immob)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
midiP <- readShapePoly(system.file("shapes/region.shp", package="GeoXp")[1])
cont_midiP<-spdf2list(midiP[-c(22,23),])$poly

# A spatial weight matrix based on triangulation Delaunay
W.nb<-tri2nb(cbind(immob$longitude,immob$latitude))

# example of use of neighbourmap
neighbourmap(immob.spdf,"prix.vente", W.nb, identify=TRUE, cex.lab=0.5,
carte=cont_midiP)
```

nonormmoran *Detection of spatial autocorrelation*

Description

The function nonnormmoran is used to detect spatial autocorrelation in the residuals u from the least squares model $Y = \beta \times X + u$. It calculates Moran's I statistic of the residuals based on the gaussian asymptotic distribution and give a p-value associated to the test of spatial autocorrelation (gaussian version).

Usage

```
nonormmoran(y, x, W)
```

Arguments

y	vector of size n of dependent variable
x	matrix $n \times p$ containing explanatory variables
W	spatial weight matrix

Details

W is supposed standartized :

$$I = (n/s)\frac{u'Wu}{u'u}$$

$$I \sim N(E(I), var(I))$$

let $M = (I - X(X'X)^{-1}X')$

$$E(I) = (n/s)\frac{tr(MW)}{n-k}$$

$$d = \frac{n-p}{n+p+2}$$

$$V(I) = (n/s)^2[tr(MWMW') + tr(MW)^2 + (tr(MW))^2]/d - E(I)^2$$

$$Z_I = \frac{I - E(I)}{v(I)^{1/2}}$$

When W is row-normalised, $s = n$ else s is the number of nonzero links

Value

a list with nobs is the number of observations, nvar, the number of explanatory variables, morani is the Moran's I statistic estimate, imean is E(I), ivar is var(I), istat is the normalized Moran's I statistic (corresponding to Z_I), and prob the associated p-value.

Note

This function is closed to the function lm.morantest included in the spdep package. nonnormmoran is less confortable to use because it didn't take into account S4 classes.

Author(s)

Translated into R from Jim Lessage's *Spatial Econometrics Toolbox*, http://www.spatial-econometrics.com/

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

moranplotmap,neighbourmap,makeneighborsw,normw

Examples

```
###
# data baltimore
data(baltimore)

# a spatial weight matrix constructed in the matrix format
W <- makeneighborsw(cbind(baltimore$X,baltimore$Y),method="neighbor",4)

# when W is not row-normalised ...
nonormmoran(baltimore$PRICE,cbind(rep(1,nrow(baltimore)),baltimore[,14:15]),W)
# when W is row_normalised ...
nonormmoran(baltimore$PRICE,cbind(rep(1,nrow(baltimore)),baltimore[,14:15]),normw(W))

# If we compare to the function lm.morantest
baltimore.lm<-lm(PRICE~LOTSZ+SQFT,data=baltimore)

lm.morantest(baltimore.lm, mat2listw(W))
```

---

normw *Row-normalize a spatial weight matrix*

Description

The function normw() row-normalizes a spatial weight matrix

Usage

```
normw(w)
```

Arguments

w	A matrix of size $n \times n$

Details

$$W_{ij} = \frac{W_{ij}}{\sum_k W_{ik}}$$

Value

A matrix of size $n \times n$

Author(s)

Aragon Y., Thomas-Agnan C., Ruiz-Gazen A., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

neighbourmap, moranplotmap,makeneighborsw

Examples

```
###
# data auckland
data(auckland)
x.ext <- auckland$Easting[1:10]
y.ext <- auckland$Northing[1:10]

# matrix based on 3 nearest neighbors
W1<-makeneighborsw(cbind(x.ext,y.ext),method="both",m=3,d=20)
W2<-normw(W1)

apply(W1[1:10,],1,sum)
apply(W2[1:10,],1,sum)
```

pcamap *Generalized Principal Component Analysis and map*

Description

The function pcamap() draws the plots summarizing a generalized Principal Component Analysis (PCA), made with genpca. It draws the scatterplot of the individuals projected on a chosen principal component plane (with their percentage of inertia), together with the scatterplot of the variables projected into the same plane with the quality of representation in order to interpret the principal component axes. The individuals scatterplot interacts with the map.

Usage

```
pcamap(sp.obj, names.var, direct=c(1,2),
weight=rep(1/nrow(sp.obj),length=nrow(sp.obj)), metric=diag(length(names.var)),
center=NULL, reduce=TRUE, qualproj=FALSE, names.attr=names(sp.obj), criteria=NULL,
carte=NULL, identify=FALSE, cex.lab=0.8, pch=16, col="lightblue3",
xlab=paste(direct[1]), ylab=paste(direct[2]), axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
names.var	a vector of character; attribute names or column numbers in attribute table
direct	Two-dimension vector containing the numbers of principal axes to plot
weight	vector of size n of weight (by default : weight=t(1/n,...,1/n))
metric	matrix $p \times p$ (by default : metric=Identity matrix)
center	A vector of size p of the gravity center which by default is equal to $\bar{X}$
reduce	if TRUE, reduced PCA
qualproj	if TRUE, print the quality of representation of individuals
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of Spatial unit, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	a vector of symbol which must be equal to the number of group else all sites are printed in pch[1]
col	a vector of colors which must be equal to the number of group else all sites and all bars are printed in col[1]
xlab	a title for the graphic x-axis

ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

Let

$$D = diag(\lambda_1, ..., \lambda_p)$$

$$1_p = (1, ..., 1)'$$

Let the coordinates of individuals in the principals components

$$CC = (C'_1, ..., C'_n)'$$

with $C_i = (C_i^1, ..., C_i^p)$
Let the coordinates of variables in the principals components

$$CC = (V'_1, ..., V'_p)'$$

with $V_i = (V_i^1, ..., V_i^p)$
Part of inertia :

$$(\frac{\lambda_1}{\sum_i \lambda_i}, ..., \frac{\lambda_p}{\sum_i \lambda_i})'$$

Quality of representation of individual k projected on plane (i,j):

$$Qu = \sqrt{\frac{(C_k^i)^2 + (C_k^j)^2}{\sum_l (C_k^l)^2}}$$

Quality of representation of variable k projected on plane (i,j):

$$VQu = \sqrt{\frac{(V_k^i)^2 + (V_k^j)^2}{\sum_l (V_k^l)^2}}$$

Value

In the case where user click on save results button, a list is created as a global variable in last.select object. obs, corresponds to the number of spatial units selected just before leaving the Tk window, inertia vector of size p with percent of inertia of each component, casecoord matrix $n \times p$ of individuals, varcoord matrix $n \times p$ of principal components.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Caussinus H., Fekri M., Hakam S., Ruiz-Gazen A. (2003) , *A monitoring display of Multivariate Outliers*, Computational Statistics and Data Analysis, vol. 44, 1-2, 237-252.

See Also

clustermap,genpca

Examples

```
###
# Data Colombus
require("maptools")
require("robustbase")
example(columbus)

# a basic PCA on 7 variables
pcamap(columbus,c(6:12), qualproj=TRUE, identify=TRUE)

###
# data boston
data(boston)

# SpatialPoints object
boston.sp<-SpatialPoints(cbind(boston.utm[,1],boston.utm[,2]))

# SpatialPointsDataFrame object
boston.spdf <- SpatialPointsDataFrame(boston.sp, boston.c)

# a basic PCA on 7 variables
pcamap(boston.spdf, c(7:8,10,12:15), identify=TRUE, cex.lab=0.5)

# generalized PCA : user have to construct a new metric and a vector
# of gravity center, by using for exampe covMcd
cov.boston<-covMcd(boston.c[,c(7:8,10,12:15)],alpha=.75)
b.center<-cov.boston$center
b.cov<-cov.boston$cov

# example of use of pcamap
pcamap(boston.spdf, c(7:8,10,12:15), metric=b.cov, center=b.center,identify=TRUE,
cex.lab=0.5)
```

plot3dmap *Interactive Plot3d and map*

Description

The function plot3dmap() draws a 3d-plot of three given variables $names.var$ and a map with sites of coordinates coordinates(sp.obj).

Usage

```
plot3dmap(sp.obj, names.var, box=TRUE,
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3",xlab="", ylab="", zlab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
names.var	a vector of three characters; attribute names or column numbers in attribute table
box	a boolean with TRUE for drawing a box on the scatterplot 3d
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of Spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the histogram
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
zlab	a title for the graphic z-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

Sites selected on the map by ‘points’ or ‘polygon’ are represented in red in the 3-d plot.

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Note

This function uses the `rgl` package and open a `rgl` device.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

scattermap

Examples

```
# data on price indices of real estate in France
######
# data on price indices of real estate in France
data(immob)
row.names(immob)<-immob$Nom

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))
# ... and then by integrating other variables to create SpatialPointsDataFrame
immob.spdf = SpatialPointsDataFrame(immob.sp, immob)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
require("maptools")
midiP <- readShapePoly(system.file("shapes/region.shp", package="GeoXp")[1])
cont_midiP<-spdf2list(midiP[-c(22,23),])$poly

# an example of plot3dmap
plot3dmap(immob.spdf, c("prix.vente","prix.location","variation.vente"),
box=FALSE, carte=cont_midiP, identify=TRUE, cex.lab=0.5,xlab="prix.vente",
ylab="prix.location", zlab="variation.vente")


######
```

```
# data eire
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))

# an example of use
plot3dmap(eire, c("A","RETSALE","INCOME"), xlab="A",ylab="RETSALE",zlab="INCOME")
```

---

polyboxplotmap *Interactive polyboxplot and map*

Description

Parallel Boxplots of a numerical variable by levels of a factor. It interacts with a map.

Usage

```
polyboxplotmap(sp.obj, names.var, varwidth=FALSE, names.arg = "",
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3",xlab="", ylab="count", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
names.var	a vector of 2 characters; first character corrseponds to the name of a factor and second character corresponds to a numeric value
varwidth	if varwidth is TRUE, the boxes are drawn with widths proportional to the square-roots of the number of observations in the groups
names.arg	a vector of level names (for factor)
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of Spatial units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	a vector of symbol which must be equal to the number of group else all sites are printed in pch[1]
col	a vector of colors which must be equal to the number of group else all sites and all box are printed in col[1]
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis

axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

Each site is associated to a value of a level of $names.var[1]$ and of a value of $names.var[2]$. There is an interactivity only in one direction : the sites selected by quartile-intervals on one of the boxplots are then represented on the map in red (or colors according to the options).

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

dblehistomap, histobarmap, scattermap, dbledensitymap

Examples

```
######
# data eire
require("maptools")
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))

# example of use of polyboxplotmap
polyboxplotmap(eire,c("pale","POPCHG"), names.arg=c("Outside Pale","Pale"),
xlab="Appartenance to the region of Pale", col=c("pink","violet"))
```

`polylist2list` *Extract from a polylist object the vertices of the polygons*

Description

The function `polylist2list()` extracts the vertices of the polygons from a `polylist` object, seperating polygons from each other by 3 rows of NaN.

Usage

```
polylist2list(data)
```

Arguments

`data`	A `polylist` object

Details

The user can then represent the coordinates of sites of a `polylist` object as background map, using the option `carte` included in all interactive functions of GeoXp.

Value

It returns a matrix of numeric values with 2 columns (x and y coordinates of the vertices of the polygons) where polygons are seperated from each other by 3 rows of NaN.

Author(s)

T. Laurent

References

Bivand R. et al. (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

`spdf2list`

Examples

```
data(eire)
eire.contours<-polylist2list(eire.polys.utm)
```

`rotation` *Transform coordinates of sites using a rotation*

Description

The function `rotation()` is used to modify coordinates of sites by a rotation with an angle equal to `angle`. This function is ude in `deriftmap`

Usage

```
rotation(coords, angle)
```

Arguments

`coords`	matrix $n \times 2$ of coordinates
`angle`	value of angle to use in rotation in degree

Details

Let:

$$x = (cos(\theta), -sin(\theta))$$

$$y = (sin(\theta), cos(\theta))$$

$$nlecoord = coords \times cbind(x, y)$$

Value

matrix $n \times 2$ of new coordinates.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

`angleplotmap`,`variocloudmap`

scattermap *Interactive scatterplot and map*

Description

The function scattermap draws a scatterplot of the given variables indicated in names.var and a map with sites of coordinates coordinates(sp.obj). Boxplots of each variable names.var[1] and names.var[2] are represented below the x-axis and y-axis.

Usage

```
scattermap(sp.obj, names.var, lin.reg=TRUE, quantiles=TRUE,
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3",xlab="", ylab="", axes=FALSE, lablong="", lablat="")
```

Arguments

sp.obj	object of class extending Spatial-class
names.var	a vector of two characters : 1st name corresponds to the x-variable, 2nd name corresponds to the y-variable
lin.reg	If TRUE, drawing of the linear predictor for 'response' in linear model
quantiles	a boolean to represent the Additive Quantile Regression Smoothing
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of Spatial Units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the histogram
xlab	a title for the graphic x-axis
ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map

Details

Each site is associated to a value of names.var[1] and a value of names.var[2]. There is an interactivity between the two windows: the sites selected by 'point' or 'polygon' on the scatterplot are represented on the map in red; sites selected on the map are then represented in red on the scatterplot. Users have the possibility to draw linear predictor for 'response' in linear model (option lin.reg) or conditionnal quantile regression spline (option quantiles).

Value

In the case where user click on `save results` button, a vector of integer is created as a global variable in `last.select` object. It corresponds to the number of spatial units selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

dblehistomap, histobarmap, scattermap, densitymap

Examples

```
######
# data on price indices of real estate in France
data(immob)
row.names(immob)<-immob$Nom

# immob is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
immob.sp = SpatialPoints(cbind(immob$longitude,immob$latitude))
# ... and then by integrating other variables to create SpatialPointsDataFrame
immob.spdf = SpatialPointsDataFrame(immob.sp, immob)
# For more details, see vignette('sp', package="sp")

# optional : we add some contours that don't correspond to the spatial unit
# but are nice for mapping
require("maptools")
midiP <- readShapePoly(system.file("shapes/region.shp", package="GeoXp")[1])
cont_midiP<-spdf2list(midiP[-c(22,23),])$poly

# a example of use
scattermap(immob.spdf,c("prix.vente","prix.location"),
carte= cont_midiP, xlab="Average sell price",ylab="Average rent price",
identify=TRUE, cex.lab=0.6)



######
```

```
# data eire
eire <- readShapePoly(system.file("etc/shapes/eire.shp", package="spdep")[1],
ID="names", proj4string=CRS("+proj=utm +zone=30 +units=km"))


# example of use of scattermap
scattermap(eire, c("ROADACC","OWNCONS"),lin.reg=TRUE,
xlab="Roads",ylab="Consomation Rate",col="purple")
```

`selectgraph` *Selection of an additionnal grah*

Description

The function `selectgraph()` is used in most of the GeoXp functions to choose an additional graph and the variables associated to this graph.

Usage

```
selectgraph(listnomvar, listgraph)
```

Arguments

`listnomvar`	list of names of variables given
`listgraph`	kind of graphics

Details

This function is not an interactive function.

Value

Names of variables and graph chosen.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23

`selectmap` *Selection of a point or polygon on a scatterplot*

Description

The function `selectmap()` is used to select a point or a polygon on the map or on a scatterplot. Called by any function which draws a scatterplot.

Usage

```
selectmap(var1, var2, obs, Xpoly, Ypoly, method = "")
```

Arguments

`var1`	a vector x of size n
`var2`	a vector y of size n
`obs`	a boolean vector of size n : TRUE if a site is already selectioned, FALSE otherwise.
`Xpoly`	X-coordinates of the vertices of selected polygon
`Ypoly`	Y-coordinates of the vertices of selected polygon
`method`	'point' if the selected area is a point; 'poly' if the selected area is a polygon

Details

This function is called by all the functions which draw a scatterplot such as `scattermap`, `moranplotmap`,... This is not an interactive function.

Value

A vector of boolean of size n. TRUE if a site has been selected, FALSE otherwise.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

`selectstat` *Selection of values on a graphic*

Description

The function `selectstat()` is used to select sites on a graphic such as Histogram, Barplot, Boxplot, Polyboxplot, Scatterplot, Densityplot, Neighbourplot, Lorentz, Moran, Angleplot, Variocloud, Cluster, or PCA. Most of the GeoXp functions call selectstat.r.

Usage

```
selectstat(var1, var2, obs, Xpoly, Ypoly, method,
nbcol, W, F, long, lat)
```

Arguments

`var1`	1st variable of size n
`var2`	2nd variable of size n
`obs`	a boolean vector of size n : TRUE if a site is already selectioned, FALSE otherwise.
`Xpoly`	X-coordinates of the vertices of selected polygon
`Ypoly`	Y-coordinates of the vertices of selected polygon
`method`	name of the graph wich must be drawn among Histogram, Barplot, Boxplot, Polyboxplot, Densityplot, Neighbourplot, Lorentz, Anglepoint, Variopoint
`nbcol`	nbcol : number of cells for the histogram (10 by default)
`W`	A matrix of size $n \times n$ (for spatial weight)
`F`	a vector of numeric
`long`	a vector of x-axis of size n
`lat`	a vector of y-axis of size n

Details

This function is not an interactive function.

Value

Return a vector of boolean of size n with TRUE if sites have been selected on a graph

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

slider1 *Scroll bar*

Description

Creates a scroll bar for modifying the value of a parameter.

Usage

```
slider1(fenetre, refresh.code, names.slide, minima, maxima, resolutions,
starts, no=0)
```

Arguments

fenetre	number of windows
refresh.code	name of function called after modifying the value of a parameter
names.slide	title for scroll bar
minima	minimum value of parameter
maxima	maximum value of parameter
resolutions	scale
starts	Initial Value
no	number of scroll bar

Details

This function is used in the functions which draw a curve to modify the smoothing parameter. This is not an interactive function

Value

Draws a Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

See Also

densitymap,dbledensitymap

spdf2list *Extract from a SpatialPolygonsDataFrame object the middle coordinates of boundary box and the vertices of the polygons (in the case where polygons are given)*

Description

The function `spdf2list()` calculates the middle coordinates of boundary box and in the case where polygons are included into a `SpatialPolygonsDataFrame` object, it extracts the vertices of the polygons, seperating polygons from each other by 3 rows of NaN.

Usage

```
spdf2list(data)
```

Arguments

`data`	A `SpatialPolygonsDataFrame` object

Details

The user can then represent the coordinates of sites of a `SpatialPolygonsDataFrame` object as background map, using the option 'carte' included in all interactive functions.

Value

It returns two vectors of middle coordinates for x-axis and y-axis cooresponding to middle of each boundary box. It returns a matrix of numeric values with 2 columns (x and y coordinates of the vertices of the polygons) where polygons are seperated from each other by 3 rows of NaN.

Note

The data of a `SpatialPolygonsDataFrame` object can be directly extract using @data

Author(s)

Thibault Laurent

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Roger S.Bivand, Edzer J.Pebesma, Virgilio Gomez-Rubio (2009), *Applied Spatial Data Analysis with R*, Springer.

See Also

polylist2list

Examples

```
require("maptools")
africa <- readShapePoly(system.file("shapes/Africa.shp", package = "GeoXp")[1])
africa.contour<-spdf2list(africa)$poly
```

---

variocloudmap *Interactive variocloud and map*

Description

The function variocloudmap() draws a semi-variocloud (directional or omnidirectional) and a map. It is used to detect spatial autocorrelation. Possibility to draw the empirical semi-variogram and a robust empirical semi-variogram.

Usage

```
variocloudmap(sp.obj, name.var, bin=NULL, quantiles=TRUE,
names.attr=names(sp.obj), criteria=NULL, carte=NULL, identify=FALSE, cex.lab=0.8,
pch=16, col="lightblue3", xlab="", ylab="", axes=FALSE, lablong="", lablat="",
xlim=NULL, ylim=NULL)
```

Arguments

sp.obj	object of class extending Spatial-class
name.var	a character; attribute name or column number in attribute table
bin	a vector of numeric values where empirical variogram will be evaluated
quantiles	a boolean to represent the Additive Quantile Regression Smoothing
names.attr	names to use in panel (if different from the names of variable used in sp.obj)
criteria	a vector of boolean of size the number of Spatial Units, which permit to represent preselected sites with a cross, using the tcltk window
carte	matrix with 2 columns for drawing spatial polygonal contours : x and y coordinates of the vertices of the polygon
identify	if not FALSE, identify plotted objects (currently only working for points plots). Labels for identification are the row.names of the attribute table row.names(as.data.frame(sp.obj)).
cex.lab	character size of label
pch	16 by default, symbol for selected points
col	"lightblue3" by default, color of bars on the cloud map
xlab	a title for the graphic x-axis

ylab	a title for the graphic y-axis
axes	a boolean with TRUE for drawing axes on the map
lablong	name of the x-axis that will be printed on the map
lablat	name of the y-axis that will be printed on the map
xlim	the x limits of the plot
ylim	the y limits of the plot

Details

For some couple of sites (s_i, s_j), the graph represents on the y-axis the semi squared difference between var_i and var_j :

$$\gamma_{ij} = \frac{1}{2}(var_i - var_j)^2$$

and on the x-absis the distance h_{ij} between s_i and s_j. The semi Empirical variogram has been calculated as :

$$\gamma(h) = \frac{1}{2|N(h)|} \sum_{N(h)} (Z(s_i) - Z(s_j))^2$$

where

$$N(h) = \{(s_i, s_j) : s_i - s_j = h; i, j = 1, ..., n\}$$

and the robust version :

$$\gamma(h) = \frac{1}{2(0.457 + \frac{0.494}{|N(h)|})}(\frac{1}{|N(h)|} \sum_{N(h)} |Z(s_i) - Z(s_j)|^{1/2})^4$$

The number N of points to evaluate the empirical variogram and the distance ϵ between points are set as follows :

$$N = \frac{1}{max(30/n^2, 0.08, d/D)}$$

and :

$$\epsilon = \frac{D}{N}$$

with :

$$D = max(h_{ij}) - min(h_{ij})$$

and :

$$d = max(h_{ij}^{(l)} - h_{ij}^{(l+1)}),$$

where $h^{(l)}$ is the vector of sorted distances. In options, possibility to represent a regression quantile smoothing spline g_α (in that case the points below this quantile curve are not drawn).

Value

In the case where user click on `save results` button, a matrix of integer is created as a global variable in `last.select` object. It corresponds to the numbers of spatial unit corresponding to couple of sites selected just before leaving the Tk window.

Author(s)

Thomas-Agnan C., Aragon Y., Ruiz-Gazen A., Laurent T., Robidou L.

References

Thibault Laurent, Anne Ruiz-Gazen, Christine Thomas-Agnan (2012), GeoXp: An R Package for Exploratory Spatial Data Analysis. *Journal of Statistical Software*, 47(2), 1-23.

Cressie N. and Hawkins D. (1980), *Robust estimation of the variogram*, in Journal of the international association for mathematical geology, 13, 115-125.

See Also

angleplotmap, driftmap

Examples

```
#####
# Data Meuse
data(meuse)

# meuse is a data.frame object. We have to create
# a Spatial object, by using first the longitude and latitude
# to create Spatial Points object ...
meuse.sp = SpatialPoints(cbind(meuse$x,meuse$y))
# ... and then by integrating other variables to create SpatialPointsDataFrame
meuse.spdf = SpatialPointsDataFrame(meuse.sp, meuse)

# meuse.riv is used for contour plot
data(meuse.riv)

# example of use of variocloudmap
variocloudmap(meuse.spdf, "zinc", quantiles=TRUE, bin=seq(0,2000,100),
xlim=c(0,2000),ylim=c(0,500000),pch=2,carte=meuse.riv[c(21:65,110:153),],
criteria=(meuse$lime==1))
```

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