Package 'SegEnvIneq'

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Type Package

Title Environmental Inequality Indices Based on Segregation Measures

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Description A set of segregation-based indices and randomization methods to make robust environmental inequality assessments, as described in Schaeffer and Tivadar (2019) ``Measuring Environmental Inequalities: Insights from the Residential Segregation Literature" <doi:10.1016/j.ecolecon.2019.05.009>.

Depends R (>= 4.4.0)

Imports sf (>= 1.0-16), spdep (>= 1.3-6), OasisR (>= 3.1.1), outliers (>= 0.15)

License GPL-2 | GPL-3

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NeedsCompilation no

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Contents

ECfunc *A function to compute environmental centralization index*

Description

Environmental Centralization index compares the spatial distribution of two social groups around a specific environmental (dis-)amenity, located at one or more points.

Usage

```
ECfunc(x, distmin = NULL, dist = NULL, K = NULL, kdist = NULL,
spatobj1 = NULL, folder1 = NULL, shape1 = NULL,
spatobj2 = NULL, folder2 = NULL, shape2 = NULL)
```

Arguments

x	a matrix with the groups distributions across spatial units
distmin	an optional vector with the minimal distance between each spatial unit and all the environmental localisations. If not provided, it will be computed in the function
dist	an optional matrix with the distance between all spatial units and environmental localisations. If not provided, it will be computed in the function
K	if provided, the version of the index constrained to the K nearest neighbors
kdist	if provided, the version of the index constrained to the nearest neighbors within a distance of kdist
spatobj1	polygons spatial objects for population distribution to compute distances matrix (necessary if distance not provided).
folder1	a character vector with the folder (directory) name indicating where the shapefile with geographical info of population distribution is located on the drive (necessary if distance and spatial object are not provided).
shape1	a character vector with the name of the shapefile (without the .shp extension) with geographical info of population distribution
spatobj2	points spatial objects for (dis-)amenity location to compute distances matrix (necessary if distance not provided).
folder2	a character vector with the folder (directory) name indicating where the shapefile with geographical info of (dis-)amenity distribution is located on the drive (necessary if distance and spatial object are not provided).
shape2	a character vector with the name of the shapefile (without the .shp extension) with geographical info of (dis-)amenity spatial location

Value

The matrix with environmental centralization index values

References

Schaeffer Y. and Tivadar M. (2019) Measuring Environmental Inequalities: Insights from the Residential Segregation Literature. *Ecological Economics*, 164, 106329

Tivadar M. (2019) OasisR: An R Package to Bring Some Order to the World of Segregation Measurement. *Journal of Statistical Software*, 89 (7), pp. 1-39

Duncan O. D. and Duncan B. (1955) Residential Distribution and Occupational Stratification. *American Journal of Sociology*, 60 (5), pp. 493-503

Folch D.C and Rey S. J (2016) The centralization index: A measure of local spatial segregation. *Papers in Regional Science*, 95 (3), pp. 555-576

See Also

EDfunc, EnvResampleTest, EnvResamplePlot

Examples

```
data(segdata, package = "OasisR")
# segdata - theoretical distributions on a 10x10 grid map
# We consider A1 and A2 - two populations distribution and
# the amenities are located in the grid center
distance <- sf::st_distance(sf::st_centroid(sf::st_as_sf(segdata)),
sf::st_centroid(sf::st_union(sf::st_as_sf(segdata))))
ECfunc (segdata@data[,3:4], dist = distance)
```

EDfunc *A function to compute environmental dissimilarity index*

Description

Environmental Dissimilarity index measures the dissimilarity between the distribution of a population group *x* and the one of an environmental (dis-)amenity *a* among spatial units. The environmental dissimilarity index has several versions: "standard" aspatial version based on Duncan & Duncan (1955) segregation index; adjusted versions with spatial interactions matrices based on contiguities (Morrill, 1991; Tivadar, 2019), boundaries, or shapes (Wong, 1998; Tivadar, 2019); or defined by the user.

Usage

```
EDfunc(x, a, vers = "standard", w = NULL, ar = NULL, per = NULL,
b = NULL, folder = NULL, shape = NULL, spatobj = NULL, queen = TRUE,
ptype = "int", K = 1, f = "exp", beta = 1)
```

Arguments

x	a vector of the population/group distribution across spatial units
a	a vector of the environmental variable spatial distribution
vers	the index version: "standard" (by default) for aspatial environmental dissimilarity index (Duncan); "contig" for adjusted index with a contiguity spatial interactions matrix (Morrill); "bound" for adjusted index with a boundaries spatial interactions matrix (Wong); "shape" for adjusted index with a boundaries and shape spatial interactions matrix (Wong); "user" for adjusted index with any user spatial interactions matrix
w	an optional spatial weights matrix. If necessary and not provided, it will be computed in the function
ar	an optional vector of spatial units area. If necessary and not provided, it will be computed in the function
per	an optional vector of spatial units perimeter. If necessary and not provided, it will be computed in the function.
b	an optional shared border matrix. If necessary and not provided, it will be computed in the function.
folder	a character vector with the folder (directory) name indicating where the shapefile with geographical info is located on the drive if the interactions matrix is computed in the function
shape	a character vector with the name of the shapefile (without the .shp extension)
spatobj	a spatial object (SpatialPolygonsDataFrame) with geographic information as alternative for the shapefile, if the interactions matrix is computed in the function
queen	logical parameter defining criteria used for contiguity matrix computation, TRUE for queen (by default), FALSE for rook
ptype	a string variable giving two options for perimeter calculation for Wong's indices: "int" to use only interior borders of spatial units and "all" to use entire borders, including to the exterior of the area
K	the order of contiguity matrix if "contig" version is chosen (K = 1 by default)
f	spatial decay function of contiguity matrix when K > 1, with f = "exp" (by default) for exponential function of contiguity "distance" exp(beta*(1-k))
beta	spatial decay intensity parameter (equal to 1 by default), used only when the version with contiguity is chosen and K > 1

Value

The value of the environmental dissimilarity index

References

Schaeffer Y. and Tivadar M. (2019) Measuring Environmental Inequalities: Insights from the Residential Segregation Literature. *Ecological Economics*, 164, 106329

Tivadar M. (2019) OasisR: An R Package to Bring Some Order to the World of Segregation Measurement. *Journal of Statistical Software*, 89 (7), pp. 1-39

Duncan O. D. and Duncan B. (1955) Residential Distribution and Occupational Stratification. *American Journal of Sociology*, 60 (5), pp. 493-503

Morrill B. (1991) On the measure of geographic segregation. *Geography research forum*, 11, pp. 25-36.

Wong D. W. S. (1998) Measuring multiethnic spatial segregation. *Urban Geography*, 19 (1), pp. 77-87.

See Also

ECfunc, EnvResampleTest, EnvResamplePlot

Examples

```
data(segdata, package = "OasisR")
# segdata - theoretical distributions on a 10x10 grid map
# We consider A1 - population distribution and A2 - amenity distribution
EDfunc (segdata@data$A1, segdata@data$A2)
EDfunc (segdata@data$A1, segdata@data$A2, vers = "contig", spatobj =segdata, queen = FALSE)
EDfunc (segdata@data$A1, segdata@data$A2, vers = "contig", spatobj =segdata, queen = FALSE, K = 3)
EDfunc (segdata@data$A1, segdata@data$A2, vers = "bound", spatobj =segdata)
EDfunc (segdata@data$A1, segdata@data$A2, vers = "shape", spatobj =segdata, ptype = 'all')
```

EnvResamplePlot *A function to test environmental inequality indices by resampling*

Description

Plot of resampling simulations results.

Usage

```
EnvResamplePlot(ResampleTest, var = 1, coldist = "red", colind = "blue", legend = TRUE,
legendpos = "top", cex.legend = 1, bty = "o")
```

Arguments

ResampleTest	a ResampleTest object produced with ResampleTest function
var	the number of the variable to be plot
coldist	color used to plot the simulated distribution
colind	color used to plot the index
legend	logical parameter, to control the legend's plots
legendpos	a character string giving the legend's position: 'bottomright', 'bottom', 'bottomleft', 'left', 'topleft', 'top', 'topright', 'right' and 'center'.
cex.legend	a numerical value giving the amount by which plotting text and symbols in legend should be magnified relative to the default.
bty	a character string which determines the type of box of the legend: 'o' (by default), 'l', '7', 'c', 'u', or ']'

Value

A plot with resampling theoretical distribution corresponding upper case letter. A value of 'n' suppresses the box.

References

Schaeffer Y. and Tivadar M. (2019) Measuring Environmental Inequalities: Insights from the Residential Segregation Literature. *Ecological Economics*, 164, 106329

Tivadar M. (2019) OasisR: An R Package to Bring Some Order to the World of Segregation Measurement. *Journal of Statistical Software*, 89 (7), pp. 1-39

See Also

EDfunc, ECfunc, EnvResampleTest

Examples

```
data(segdata, package = "OasisR")
# segdata - theoretical distributions on a 10x10 grid map
# We consider A1 - population distribution and A2 - amenity distribution
testoutput <- EnvResampleTest (x = segdata@data$A1, a = segdata@data$A2, spatobj = segdata,
fun = "EDfunc", vers = "contig", queen = FALSE)
EnvResamplePlot(testoutput)
```

EnvResampleTest *A function to test environmental inequality indices by resampling*

Description

Resampling tests for environmental inequality indexes.

Usage

```
EnvResampleTest(x, a = NULL, fun, simtype = "MonteCarlo",
nsim = NULL, sampleunit = "unit", proba = NULL, perc = c(.05, .95),
outl = FALSE, outmeth = "bp", sdtimes = 2, IQRrange = 1.5,
spatobj = NULL, folder = NULL, shape = NULL,
spatobj1 = NULL, folder1 = NULL, shape1 = NULL,
spatobj2 = NULL, folder2 = NULL, shape2 = NULL,
distmin = NULL, dist = NULL, K = NULL, kdist = NULL,
vers = "standard", w = NULL, b = NULL, ar = NULL, per = NULL,
queen = TRUE, ptype = "int", f = "exp", beta = 1)
```

Arguments

x	a vector of the population/group distribution across spatial units for EDfunc or a matrix with the groups distributions across spatial units for ECfunc
a	a vector of the environmental variable spatial distribution for EDfunc
fun	a character vector with the function to be tested, fun = "EDfunc" or fun = "ECfunc"
simtype	a character vector with the type of simulation. If simtype = 'MonteCarlo' (by default), the function produces a randomization test using Monte Carlo simulations. If simtype = 'Jack', the function generates jackknife replications
nsim	the number of simulations (equal to the number of observations for jackknife)
sampleunit	for jackknife replicant, the resampling is made only on spatial units. For Monte Carlo simulations, the user can choose between "unit" for spatial units resampling and "ind" for population resampling.
proba	for Monte Carlo simulations on population, proba is a vector with location probabilities. If proba = NULL, the vector is equiprobable. If outliers are determined with jackknife technique, proba indicates the probability (confidence interval) for scoring tests.
perc	percentille values for jackknife simulations
outl	logical parameter for jackknife simulations, if TRUE the function provides the outliers obtained by jackknife iterations
outmeth	a character vector designing the outliers detection method: outmeth = 'bp' (by default) for boxplot method; outmeth = 'sd' for standard deviation method; outmeth = 'z' for normal scores method; outmeth = 't' for t Student scores method; outmeth = 'chisq' for chi-squared scores method; outmeth = 'mad' for median absolute deviation method. The estimations based on scoring methods are obtained using outliers package
sdtimes	multiplication factor of the standard deviation used for outliers detection with jackknife simulations (2 by default)
IQRrange	determines the boxplot thresholds (1.5 by default) as multiplication of IQR (Inter Quartile Range)
spatobj	a spatial object (SpatialPolygonsDataFrame) for EDfunc geographic functions
folder	a character vector with the folder (directory) containing the shapefile for EDfunc
shape	a character vector with the name of the shapefile for EDfunc as alternative to spatobj
spatobj1	polygons spatial objects for population distribution to compute distances matrix for ECfunc
folder1	a character vector with the folder (directory) containing the shape1 for ECfunc
shape1	a character vector with the name of the shapefile for ECfunc as alternative to spatobj1
spatobj2	points spatial objects for (dis-)amenity location to compute distances matrix for ECfunc
folder2	a character vector with the folder (directory) containing the shape2 for ECfunc

shape2	a character vector with the name of the shapefile for ECfunc as alternative to spatobj2
distmin	an optional vector for ECfunc with the minimal distance between each spatial unit and all the environmental localisations
dist	an optional matrix for ECfunc with the distance between all spatial units and environmental localisations.
K	the order of contiguity matrix if "contig" version of EDfunc is chosen (K = 1 by default)
kdist	if provided, the version of the index constrained to the nearest neighbors within a distance of kdist
vers	the EDfunc version: "standard" (by default) for aspatial environmental dissimilarity index (Duncan); "contig" for adjusted index with a contiguity spatial interactions matrix (Morrill); "bound" for adjusted index with a boundaries spatial interactions matrix (Wong); "shape" for adjusted index with a boundaries and shape spatial interactions matrix (Wong); "user" for adjusted index with any user spatial interactions matrix
w	an optional spatial weights matrix for EDfunc.
b	an optional shared border matrix for EDfunc.
ar	an optional vector of spatial units area for EDfunc.
per	an optional vector of spatial units perimeter for EDfunc.
queen	logical parameter for EDfunc defining criteria used for contiguity matrix computation, TRUE for queen (by default), FALSE for rook
ptype	a string variable for EDfunc giving two options for perimeter calculation for Wong's indices: "int" to use only interior borders of spatial units and "all" to use entire borders, including to the exterior of the area
f	spatial decay function of contiguity matrix for EDfunc when K > 1, with f = "exp" (by default) for exponential function of contiguity "distance"
beta	spatial decay intensity parameter for EDfunc (equal to 1 by default), used only when the version with contiguity is chosen and K > 1

Value

A list with: - index's name - simulation type - statistics summary of the simulations - simulated index distribution - simulated population distribution - matrix with outliers (jackknife) - list with outliers values (jackknife)

References

Schaeffer Y. and Tivadar M. (2019) Measuring Environmental Inequalities: Insights from the Residential Segregation Literature. *Ecological Economics*, 164, 106329

Tivadar M. (2019) OasisR: An R Package to Bring Some Order to the World of Segregation Measurement. *Journal of Statistical Software*, 89 (7), pp. 1-39

See Also

EDfunc, ECfunc, EnvResamplePlot

Examples

```
data(segdata, package = "OasisR")
# segdata - theoretical distributions on a 10x10 grid map
# We consider A1 - population distribution and A2 - amenity distribution
testoutput <- EnvResampleTest (x = segdata@data$A1, a = segdata@data$A2, spatobj = segdata,
fun = "EDfunc", vers = "contig", queen = FALSE)
testoutput$Summary
hist(testoutput$IndexDist)
```

Index