Package 'spatialsegregation'

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Type Package

Title Segregation measures for multitype spatial point patterns

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Suggests

Depends spatstat

Description Summaries for measuring segregation/mingling in multitype spatial point patterns with graph based neighbourhood description. Included indices: Mingling, Shannon, Simpson (also the non-spatial) Included functionals: Mingling, Shannon, Simpson, ISAR. Included neighbourhoods: Geometric, k-nearest neighbours, Gabriel, Delauney.

License GPL (>= 2.0)

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R topics documented:

spatialsegregation-package
Spatial Segregation Measures

Description

Collection of measures or summaries of spatial multitype exposure: segregation vs. mingling.

Details

Date:	2009-09-06
License:	GPL v2 or later

This is a collection of summaries for multitype spatial point patterns (check package 'spatstat' for more info about them). The package is developed for the article Rajala&Illian 2009, and consists of summaries for detecting inter-type forces in the pattern.

See the helps of one of the function for further information how to use the package.

```
Functions
------------------
segregationFun   -   General calculation function, please use one of the following
minglingF        -   Mingling index
shannonF         -   spatial Shannon index
simpsonF         -   spatial Simpson index
isarF            -   ISAR function
mingling.index   -   shortcut for a single value
shannon.index    -   -''-
simpson.index    -   -''-
isar.index       -   -''-
```

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References

Graz: The behaviour of the species mingling index m_{sp} in relation to species dominance and dispersion. Eur. J. forest research. 123:87-92, 2004.

Lewandowski, Pommerening: Zur Beschreibung der Waldstruktur - Erwartete und beobachtete Arten-Durchmischung. Forstwiss Centralbl, 116:129-139, 1997.

Rajala, Illian: Graph-based description of mingling and segregation in multitype spatial point patterns. To appear 2009.

Reardon, O'sullivan: Measures of spatial segregation. Sociological methodology, 34:121-162, 2004.

Shimatani, Kubota: Quantitative assesment of multispecies spatial pattern with high species diversity. Ecological Research, 19, 2004.

Wiegand, Gunatilleke, Gunatilleke, Huth: How individual species structure diversity in tropical forests. PNAS, nov 16, 2007.

`spatialsegregation-helpers`

Functions for the aid of segregation measures

Description

Small functions included in package `spatialsegregation`, used for manipulation of forest datasets which have dbh-values (pp with a component dbh).

Usage

```
clean.up.data(pp, dbh = 10, atleast = 10)
freqs(pp)
minusID(pp, minusR, dbh = 0, atleast = 0)
shake(pp, a = 0.001)
```

Arguments

`pp`	Multitype point pattern (see package 'spatstat')
`atleast`	Include specii with abundance atleast `atleast`.
`dbh`	Include only those points with dbh atleast `dbh`.
`minusR`	Range from the border withing which to exluce points (used for correction of estimates).
`a`	Size of displacement: x+Unif(-a,a), y+Unif(-a,a).

Details

Date:	2009-04-03
License:	GPL v2 or later

Small functions to manipulate multitype point patterns.

`clean.up.data`: Returns a subsample fullfilling the given constrains.

`freqs`: Returns the abundance vector.

`minusID`: Returns a 0-1-vector indicating inclusion in a simple minus-correction.

`shake`: Shakes the pattern, i.e. adds a random displacement shift to each point.

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spatialsegregation-ISAR

Individual Species Area Relationship

Description

Compute the Individual Species Area Relationship (ISAR), or Local Species Richness, for a given multitype point pattern.

Usage

```
isarF(X, r=NULL, target=NULL, v2=FALSE, ... )
isar.index(X, r=4, ntype="knn", ...)
```

Arguments

X	Multitype point pattern of class ppp (see package 'spatstat')
r	Vector of sizes for neighbourhoods, e.g. geometric graph with different ranges.
target	Default NULL. Calculate only for target type. If NULL compute mean over all types.
v2	Logical. Estimate species/neighbours -ratios instead of just species/1.
ntype	Set the default in isar.index to knn neighbourhood type.
...	Further parameters for the function segregationFun.

Details

Date:	2009-09-06
License:	GPL v2 or later

Extension of ISAR-function introduced in WGGH07. In effect calculates the expected amount of different types present in the neighbourhood of a point in the pattern.

The function isarF is the calculation function for different neighbourhoods. Uses function segregationFun.

The function isar.index is a shortcut to get a single value for the pattern. Uses 4-nn graph by default.

Value

Returns an fv-object, see spatstat for more information.

Author(s)

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References

Rajala, Illian: Graph-based description of mingling and segregation in multitype spatial point patterns. To appear 2009.

Wiegand, Gunatilleke, Gunatilleke, Huth: How individual species structure diversity in tropical forests. PNAS, nov 16, 2007.

`spatialsegregation-mingling`
Spatial Mingling Index

Description

Compute the Mingling index for a given multitype point pattern.

Usage

```
minglingF(X, r=NULL, target=NULL, ratio=FALSE, ...)
mingling.index(X, r=4, ntype="knn", ...)
```

Arguments

`X`	Multitype point pattern of class `ppp` (see package 'spatstat')
`r`	Vector of sizes for neighbourhoods, e.g. `geometric` graph with different ranges.
`target`	Default NULL. Calculate only for target type. If NULL compute mean over all types.
`ratio`	Default FALSE. If TRUE, scale the typewise values `$M_t$` using formula `$(1-M_tau)/lambda_tau$` which equals 1 for Poisson CSR.
`ntype`	The original mingling index uses `knn` neighbourhood type.
`...`	Further parameters for the function `segregationFun`.

Details

Date:	2009-09-06
License:	GPL v2 or later

Extension of Mingling index introduced by Lewandowski&Pommerening 1997. Measures the proportion of alien points in the neighbourhood of a specific type typical point of the pattern.

If no specific type is given, the function takes mean over all types. A typewise value is more useful, so they are also included.

The function `minglingF` is the main calculation function. Uses function `segregationFun`.

The function `mingling.index` is a shortcut to get a single value for the pattern. Uses 4-nn graph by default, which is the original Mingling index used by Lewandowski&Pommerening 1997 and

Graz 2004.

Value

Returns an fv-object, see spatstat for more information.

Author(s)

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References

Graz: The behaviour of the species mingling index m_{sp} in relation to species dominance and dispersion. Eur. J. forest research. 123:87-92, 2004.

Lewandowski, Pommerening: Zur Beschreibung der Waldstruktur - Erwartete und beobachtete Arten-Durchmischung. Forstwiss Centralbl, 116:129-139, 1997.

Rajala, Illian: Graph-based description of mingling and segregation in multitype spatial point patterns. To appear 2009.

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spatialsegregation-segregationFun

Spatial Segregation Function

Description

Compute the spatial exposure (segregation vs. mingling) features from a given multitype point pattern. Usage of shortcuts minglingF, isarF, shannonF and simpsonF highly recommended.

Usage

```
segregationFun(X, fun="isar", r=NULL, ntype="geometric", funpars=NULL,
                        toroidal=FALSE, minusRange=0,  included=NULL, dbg=FALSE,
                            doDists=FALSE, prepRange=0.0, prepGraph=NULL, prepGraphI
```

Arguments

X	Multitype point pattern of class ppp (see package 'spatstat')
fun	Default "isar". Takes "isar","mingling","shannon" and "simpson", see below.
r	Vector for the neighbourhood defining graph, e.g. "geometric" graph with different ranges. See below.
ntype	Default "geometric". Type of the neighbourhood graph. Accepts: "knn", "geometric", "delauney", "gabriel".
funpars	Default NULL. Parameter(s) for the measure. Mingling: c(i,j), where i= only for type i (0 for all), j=1 -> ratio version. ISAR: i, i=type (integer). Shannon: 0 or 1, see v2 in shannonF. Simpson: none.

`toroidal`	Default FALSE. If TRUE, use a toroidal correction in distance calculation. Works at the moment only for rectangular windows and "geometric" or "knn" graph.
`minusRange`	If given, `included`-vector is created with points with distance atleast minusRange from the border.
`included`	boolean-vector of length |pp|. included[i]==TRUE => pp[i] included in calculations.
`dbg`	Default FALSE. Print additional runtime texts.
`doDists`	Default TRUE. Precalculate distances for speed. Be aware of memory requirements, n*(n-1)!
`prepRange`	Default 0. If >0, shrink the search space for neighbourhoods by searching only points within distance R i.e. precalculates a geometric graph.
`prepGraph`	Precalculated graph for the point pattern. If given, The `prepRange`, `dodists` and `toroidal` are ignored and calculations are carried using the prepGraph as a starting point. Useful for huge datasets.
`prepGraphIsTarget`	If TRUE, precalculated graph `prepGraph` is used to calculate a single function value directly, all other neighbourhood parameters are ignored.

Details

This is the general function for computing the spatial exposure (segregation/mingling) features. Used by minglingF, shannonF, simpsonF and isarF, which should be preferred for better (and nicer) outcome.

Possible neighbourhood relations for the spatial version include geometric, k-nearest neighbours, Delauney, and Gabriel. Delauney and Gabriel are parameter free, so given `r` has no meaning. In geometric graph, `r` is a vector of distances (sizes of the surrounding 'disc') and for k-nn `r` is the vector of neighbourhood abundances for each point to consider in the calculation of the spatial exposure measures. The basic type of spatial summary uses range, or 'geometric' graph connections with varying neighbourhood parameter.

For `geometric` and `knn`, the calculations are done by shrinking the graph given by the largest value of `r`. If dealing with large datasets, it is advisable to give preprocessing range, `prepRange`. The algorithm first calculates a geometric graph with parameter `prepRange`, and uses this as basis for finding the needed neighbourhoods. Speeds up calculations. `prepGraph`, if given, works as the preprocessed geometric graph. But make sure `prepRange` is large enough (e.g. in `geometric`, `prepRange`>max(`r`)).

The `doDists` option speeds up calculations by precomputing the pairwise distances but takes n*(n-1) memory!

For border correction, use `minusRange` for reduced border correction (for rectangular windows only). If using `geometric` or `knn` neighbourhoods, the option `toroidal` for toroidal correction is also available. The vector `included` can be given for more specific `minus`-correction, only those points with TRUE (1) value are used in calculation. However, the neighbourhoods are calculated with all points.

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License: GPL v2 or later

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`spatialsegregation-shannon`
Spatial Shannon Index

Description

Compute the spatial and aspatial Shannon index for a given multitype point pattern.

Usage

```
shannonF(X, r=NULL, v2=FALSE, ...)
shannon.index(X, spatial=FALSE, ...)
```

Arguments

`X`	Multitype point pattern of class `ppp` (see package 'spatstat')
`r`	Vector of sizes for neighbourhoods, e.g. `geometric` graph with different ranges.
`spatial`	If FALSE, return the classical aspatial index value.
`v2`	If TRUE, use the real number of types in neighbourhoods as the log-base instead of total population type count.
`...`	Further parametes for the function `segregationFun`.

Details

Date: 2009-09-06
License: GPL v2 or later

The form of Shannon index is *H = 1 - E(o)/E(N)*, where *E(N)* is the global entropy and *E(o)* is the local entropy calculated as *E(o)= - sum pi_tau log(pi_tau)*, where the sum is over the types of the pattern, and *pi_tau* is the expected relative frequency of type *tau* points in a neighbourhood of a typical point of the pattern.

The function `shannonF` is the calculation function. Uses function `segregationFun`.

The function `shannon.index` is a shortcut to get the non-spatial Shannon index.

Value

Returns an `fv`-object, see `spatstat` for more information.

Author(s)

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References

Rajala, Illian: Graph-based description of mingling and segregation in multitype spatial point patterns. To appear 2009.

Reardon, O'sullivan: Measures of spatial segregation. Sociological methodology, 34:121-162, 2004.

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spatialsegregation-simpson

Spatial Simpson Index

Description

Compute the spatial and aspatial Simpson index for a given multitype point pattern.

Usage

```
simpsonF<-function(X, r=NULL, ...)
simpson.index(X, spatial=FALSE, ...)
```

Arguments

X	Multitype point pattern of class ppp (see package 'spatstat')
r	Vector of sizes for neighbourhoods, e.g. geometric graph with different ranges.
spatial	If FALSE, return the classical aspatial index value.
...	Further parametes for the function segregationFun.

Details

Date:	2009-03-09
License:	GPL v2 or later

The form of Simpson index is *S = 1 - sum pi_tau*, where the sum is over the types of the pattern, and *pi_tau* is like in Shimatani& Kubota 2004.

The function simpsonF is the main calculation function. Uses function segregationFun.

The function simpson.index is a shortcut to get a single value for the pattern. Uses 4-nn graph by default.

Value

Returns an `fv`-object, see `spatstat` for more information.

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References

Rajala, Illian: Graph-based description of mingling and segregation in multitype spatial point patterns. To appear 2009.

Shimatani, Kubota: Quantitative assesment of multispecies spatial pattern with high species diversity. Ecological Research, 19, 2004.

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