Package 'stppSim'

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Type Package

Title Spatial and Temporal Point Patterns Simulation for Social Science Research

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Description For generating artificial spatio-temporal point patterns for use in Social Science research. Allows specified spatial and temporal signatures be integrated with urban landscape configuration to build usable point patterns/cloud for model building, testing, and evaluation. Notable potential application areas include crime science and epidemiology.

Language en-US

License GPL-3

URL https://github.com/MAnalytics/stppSim

BugReports https://github.com/Manalytics/stppSim/issues/new/choose

Depends R (>= 4.0.0)

Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

Imports splancs,
dplyr,
magrittr,
utils,
sf,
rgdal,
sp,
terra,
raster,
SiMRiv,
ggplot2,
chron,
data.table,
tibble

RoxygenNote 7.1.1

Suggests knitr,
rmarkdown

R topics documented:

`camden_boundary` *A boundary shapefile*

Description

A boundary shapefile

Usage

```
camden_boundary
```

Format

A boundary file (ESRI format)

- x: x coordinate
- y: y coordinate

`constrained_spo` *Simulate spatial point origins constrained by the social configuration of the urban space.*

Description

Simulate event origins (EOs) on a land use map (contrained space) with binary classes `1` and `0`, representing active and non-active origins. An `active` origin can generate events while a `non-active` origin can not generate events. Each active origin is assigned a probability value (representing the intensity) at which the origin generates events in accordance with a specified Pareto ratio.

Usage

```
constrained_spo(bpoly, p_ratio = 5,
show.plot=FALSE)
```

Arguments

bpoly	(A dataframe or S4 object) A dataframe of X, Y coordinates or a spatial boundary (as "SpatialPolygonsDataFrame", "SpatialPolygons", or "sf") representing the boundary within which events are to be generated. Must include a field named class with entries 1's} and \code{0's (i.e. binary) representing the active and non-active origins, respectively.
p_ratio	(an integer) The smaller of the two terms of a Pareto ratio. For example, for a 20:80 ratio, p_ratio will be 20. Default value is 30. Valid inputs are 10, 20, 30, 40, and 50. A 30:70, represents 30% dominant and 70% non-dominant origins.
show.plot	(TRUE or FALSE) To display plot showing base map (i.e. social configuration of the landscape, in terms of active and non-active spaces), and the event origins.

Details

Note: The class field of 'bpoly' will be utilized for mapping the basemap.

Value

Returns the event origins constraint by the social configuration of the space

References

#https://online.stat.psu.edu/stat510/lesson/6/6.1

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extract_coords *Extracting coordinates of a polygon boundary*

Description

Given a polygon object, the goal is to extract the coordinates of the edges of the boundary.

Usage

```
extract_coords(poly)
```

Arguments

poly	(a spatialPolygons, spatialPolygonDataFrames, or an "sf"). The polygon object must be in a Cartesian coordinate reference system.

Value

Returns the global temporal pattern

References

https://www.google.co.uk/

gtp *Modeling of the Global Temporal Pattern*

Description

Models the global temporal pattern (of the point process) as consisting of the global linear trend and the seasonality.

Usage

```
gtp(start_date = "01-01", t_resolution = 1, trend = "stable",
slope = "NULL", first_s_peak=90, show.plot =FALSE)
```

Arguments

start_date	The start date of the study period. Default value is "01-01" (i.e. January 1st). By default the end date of the study period is set as "12-31" (i.e. 31st December). A user can specify any start date in the format "mm/dd". The end date is the next 365th day from the specified start date.
t_resolution	(character) The temporal resolution at which events are re-generated (or repeated). Specified in number of days. Default:1 (currently the only option available).
trend	(a character) Specifying the direction of the global (linear) trend of the point process. Three options available are "decreasing", "stable", and "increasing" trends. Default: "stable".
slope	(a character) Slope angle for an "increasing" or "decreasing" trend. Two options are available: "gentle" and "steep". Default value is "NULL" for the default trend (i.e. stable).
first_s_peak	Number of days before the first seasonal peak. Default: 90. This implies a seasonal cycle
show.plot	(TRUE or False) To show the time series plot. Default is FALSE.

Value

Returns the global temporal pattern

References

#https://online.stat.psu.edu/stat510/lesson/6/6.1

make_grids *Make Square Grids System*

Description

Generates a system of square grids over a specified spatial boundary.

Usage

```
make_grids(poly, size = 250,
show.output = FALSE, dir=NULL)
```

Arguments

poly	(as spatialPolygons, spatialPolygonDataFrames, or simple features). A spatial polygon over which the spatial grid is to be overlaid. Needs to be in a cartesian CRS.
size	Square grid size to be generated.
show.output	(logical) To show the output. Default: FALSE
dir	(character) Specifies the directory to To be in the same unit associated with the poly (e.g. metres, feets, etc.). Default: 200. export the output. Default is NULL, indicating the current working directory (cwd). A user can specify a different directory in the format: "C:/.../folder".

Value

Returns a spatial square grid system in a shapefile format

References

https://www.google.co.uk/

poly *Boundary Coordinates of Camden Borough of London*

Description

Boundary Coordinates of Camden Borough of London

Usage

```
poly
```

Format

A dataframe containing one variable:

- x: x coordinate
- y: y coordinate

poly_tester *Test the geometry and CRS of a polygon*

Description

To test that a polygon has the correct geometry as well as a linear or Cartesian CRS.

Usage

```
poly_tester(poly)
```

Arguments

poly	(as spatialPolygons, spatialPolygonDataFrames, or simple features). A spatial polygon representing a landscape coverage.

Value

Returns error messages if the polygon is not in correct geometry or CRS.

References

#https://google.co.uk

psim *Modeling of the Global Temporal Pattern*

Description

Models the global temporal pattern (of the point process) as consisting of the global linear trend and the seasonality.

Usage

```
psim(
  n,
  spo,
  start_date,
  s_threshold = 50,
  st_skewness = 0.5,
  step_length = 20,
  poly,
  show.data = TRUE,
  trend,
  slope,
  first_s_peak,
  npoints,
  p_ratio
)
```

Arguments

n	(integer) Total Number of events to simulate.
spo	(a list or dataframe) A list of spatial boundary coordinates (or shapefile) within which the events are confined. Should be generated using random_spo or constrained_spo function.
start_date	The start date of the study period. Default value is "01-01" (i.e. January 1st). By default the end date of the study period is set as "12-31" (i.e. 31st December). A user can specify any start date in the format "mm/dd". The end date is the next 365th day from the specified start date.
s_threshold	(numeric) Spatial threshold value. The (assumed) spatial range within which events are re-generated (or repeated) by or around the same origin. Default: 250 (in the same linear unit as the poly) Default:"daily". Other values are: "weekly","monthly".
st_skewness	(numeric) The tightness of events in space and time. The value ranges from 0 -1, with event volume being skewed towards the dominant origins, as the value tends to 1. Default: 0.5. This index also controls the total volume of events across space and time.
step_length	(numeric) A maximum step taken at a time by a walker from one state to the next. Should be a fraction of the spatial units of the landscape. Default: half the size of the minimum spatial unit in a landscape (for a constraint landscape) or
poly	(as spatialPolygons, spatialPolygonDataFrames, or simple features). A spatial polygon defining the boundary within which events are to be generated.
show.data	(TRUE or FALSE) To show the output data Default is FALSE.
trend	(a character) Specifying the direction of the global (linear) trend of the point process. Three options available are "decreasing", "stable", and "increasing" trends. Default: "stable".
slope	(a character) Slope angle for an "increasing" or "decreasing" trend. Two options are available: "gentle" and "steep". Default value is "NULL" for the default trend (i.e. stable).
first_s_peak	Number of days before the first seasonal peak. Default: 90. This implies a seasonal cycle of 180 days.
npoints	(an integer) Number of origins (points) to simulate
p_ratio	(an integer) The smaller of the two terms of a Pareto ratio. For example, for a 20:80 ratio, p_ratio will be 20. Default value is 30. Valid inputs are 10, 20, 30, 40, and 50. A 30:70, represents 30% dominant and 70% non-dominant origins.

Value

Returns the global temporal pattern

References

#https://online.stat.psu.edu/stat510/lesson/6/6.1

p_prob *Pareto Probability distribution*

Description

Given a specified number of points n, this function generates an n probability values in accordance with a specified Pareto ratio.

Usage

```
p_prob(npoints,  p_ratio = 30)
```

Arguments

npoints	(an integer) Number of points. Default is 50.
p_ratio	(an integer) The smaller of the two terms of a Pareto ratio. For instance, for a 20:80 ratio, p_ratio will be 20. Default value is 20. Input values must be 5, 10, 20, 30, or 40. The 'p_ratio' determines the proportion of points that are the most dominant event generators.

Value

Returns the global temporal pattern

References

https://www.google.co.uk/

random_spo *Simulate random origins for spatial points*

Description

Simulate point origins for generating the spatial point across the area. Each origin is assigned a probability value (representing the relative intensity) at which the origin generates events in accordance with a specified Pareto ratio.

Usage

```
random_spo(poly, npoints, p_ratio, show.plot=FALSE)
```

Arguments

poly	(A dataframe or S4 object) A dataframe of X, Y coordinates or a spatial boundary (as "SpatialPolygonsDataFrame", "SpatialPolygons", or "sf") representing the boundary within which events are to be generated.
npoints	(an integer) Number of origins (points) to simulate
p_ratio	(an integer) The smaller of the two terms of a Pareto ratio. For example, for a 20:80 ratio, p_ratio will be 20. Default value is 30. Valid inputs are 10, 20, 30, 40, and 50. A 30:70, represents 30% dominant and 70% non-dominant origins.
show.plot	(TRUE or FALSE) To display plot showing points (origins).

Value

Returns random event origins

References

#https://online.stat.psu.edu/stat510/lesson/6/6.1

`regular_poly` *A rectangular boundary coordinates*

Description

A rectangular boundary coordinates

Usage

```
regular_poly
```

Format

A dataframe containing one variable:

- x: x coordinate
- y: y coordinate

`San_Francisco` *A land use shapefile of a portion of San Francisco City, United States*

Description

A land use shapefile of a portion of San Francisco City, United States

Usage

```
San_Francisco
```

Format

A boundary file (ESRI format)

- landuse_1: land use categories denoting the social configuration of the urban space
- class: a binary field indicating origins that have the ability to generate events ('1') and origins that lack the ability to generate points ('0').

walker *A landscape walker*

Description

An object capable of walking across a constraint or unconstrained landscape landscape, in accordance with a specified spatial and temporal properties. The object may or may not generates event(s) while navigating across the landscape, based on an embedded transition matrix.

Usage

```
walker(n = 5, s_threshold = 250, step_length = 20,
poly, coords=c(0,0), show.plot = FALSE)
```

Arguments

n	(integer) The number of events to be generated. Default: 5.
s_threshold	(numeric) Spatial threshold value. The (assumed) spatial range within which events are re-generated (or repeated) by or around the same origin. Default: 250 (in the same linear unit as the poly)
step_length	(numeric) A maximum step taken at a time by a walker from one state to the next. Should be a fraction of the spatial units of the landscape. Default: half the size of the minimum spatial unit in a landscape (for a constraint landscape) or Landscape Area/Number of origins * 100 for an unconstrained landscape. Users are encouraged to input a value that produce a desirable output.
poly	(as spatialPolygons, spatialPolygonDataFrames, or simple features). A spatial polygon defining the boundary within which a walker walks.
coords	a vector of the form c(x, y) giving the initial coordinates of the walker (e.g. an origin). Default: c(0,0).
show.plot	(TRUE or False) To show the time series plot. Default is FALSE.

Value

Returns a trace of walker's path, and the corresponding events.

References

#https://google.co.uk

Index