Package ‘cartogramR’

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Title Continuous Cartogram

Description Procedures for making continuous cartogram. Procedures available are:
fast flow based cartogram (Gastner, Seguy & More (2018) <doi:10.1073/pnas.1712674115>),
rubber band based cartogram (Dougenik et al. (1985)

Depends R (>= 3.5.0)
Imports sf, data.table
Suggests lwgeom
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Coerce an object to a sf object

Description

Coerce an object to a sf object

Usage

as.sf(x, ...)

Arguments

x

object to be coerced

\dots

arguments passed to or from other methods.

Value

an sf object

Index

as.sf
as.sf.cartogramR

Coerce a cartogramR to a sf object

Description

Coerce a cartogramR to a sf object returning the sf object used to construct the cartogram with the cartogram as geometry and some more attributes

Usage

## S3 method for class 'cartogramR'
as.sf(x, ...)

Arguments

- **x**: a cartogramR object
- **\dots**: arguments passed to or from other methods.

Value

A sf object including all the data (attributes) contained in the original sf object used to construct the cartogram and

- original areas of region (orig_area)
- final/deformed areas of region (final_area)
- target areas of region (target_area)
- original centers (x_orig_centers and y_orig_centers)
- final centers (x_final_centers and y_final_centers)

as.sfc

Coerce an object to a sfc object

Description

Coerce an object to a sfc object

Usage

as.sfc(x, ...)

Arguments

- **x**: object to be coerced
- **\dots**: arguments passed to or from other methods.
as.sfmultipolygon

Value

a sfc object

as.sfc.cartogramR

Coerce a cartogramR to a sfc object

Description

Coerce a cartogramR to a sfc object extracting the component cartogram of the cartogramR object

Usage

## S3 method for class 'cartogramR'
as.sfc(x, ...)

Arguments

x

a cartogramR object

... arguments passed to or from other methods.

Value

a sfc object

as.sfmultipolygon

Transform a sf object with several rows (polygons) by region to an sf object with one row by region and thus one multipolygon by region

Description

Transform a sf object with several rows (polygons) by region to an sf object with one row by region and thus one multipolygon by region

Usage

as.sfmultipolygon(data, idregion, closepolygon = FALSE)

Arguments

data

a sf object

idregion

a character string which indicates the name of the column (in data object) which contains the region identifier.

closepolygon

a boolean (default to FALSE) if TRUE it controls if polygons are closed and if not add the first vertice at the end.

Value

a sf object with one row by region and one multipolygon by region.
Description

Make a continuous cartogram (density equalizing maps)

Usage

```r
cartogramR(
  data,
  count,
             "DougenikChrismanNiemeyer"),
  options = NULL
)
```

Arguments

data: a sf object which contains at least two columns: obviously a geometry column (giving the map) and a column which contains a count by region (leading to a density by region, density to be equalized by deformation). Each row of `data` is a region and contains the simple feature geometry of type POLYGON or MULTIPOLYGON. Polygon ring directions are not checked but exterior ring must counter clockwise and holes clockwise (use option `check_ring_dir` of `sf::st_read` to achieve the right orientation of ring direction on import or use `check_ring_dir` function)

count: a character string which indicates the name of the column (in `data` object) which contains the count by region.

method: the method to be used, can be one of the following: `gsm` or `GastnerSeguyMore` (default), `gn` or `GastnerNewman`, `dcn` or `DougenikChrismanNiemeyer`.

options: a named list given to `cartogramR_options` function which process options see `cartogramR_options` for details. Default to `NULL`.

Value

A list with the following components:

- cartogram: a sf object (in the same order of `data` or sorted by `idregion` see reordered argument) which contains the cartogram (ie the initial polygons after deformation)
- orig_area: original areas of regions
- final_area: final areas of regions in the cartogram
- orig_centers: the initial centers calculated with `st_point_on_surface`
- final_centers: the centers after deformation
• gridx: (for flow-based method) final grid (x-axis) if requested (see cartogramR_options for details).
• gridy: (for flow-based method) final grid (y-axis) if requested (see cartogramR_options for details).
• count: the count by region
• target_area: target areas of regions
• initial_data: the initial sf object
• details: names of original data, idcount variable, algorithm
• options: values of options

References


Examples

data(usa)
carto <- cartogramR(usa, "electors64")
plot(carto)
summary(carto)

Description

Set the options of cartogramR in the correct format

Usage

cartogramR_options(
options,
           "DougenikChrismanNiemeyer")
)
Arguments

options a named list with some (or all) the following components:

- **maxit**: (all method) the maximum number of iterations, default to 50.
- **absrel**: (all method) boolean, if TRUE relative convergence if FALSE absolute convergence (default to TRUE)
- **abseror**: (all method) Areas on cartogram differ at most by an (absolute value of) error of abserror. That is, max_polygons area_on_cartogram - target_area <= abseror (default to 10000)
- **abstol**: ("dcn") the absolute convergence error tolerance: max_polygons area(i) - area(i-1) <= abstol (default to 1000)
- **releror**: (all method) Areas on cartogram differ at most by an (absolute value of) relative error of relerror. That is, max_polygons area_on_cartogram / target_area - 1 <= relerror (default to 0.01)
- **reltol**: ("dcn") the absolute convergence tolerance: max_polygons abs(area(i) - area(i-1))/area(i-1) <= reltol (default to 1e-3)
- **L**: ("gsm" or "gn") integer, gives the value of L (default is 512), must be a power of two (for fftw)
- **mp**: (all method) if a region contains exactly zero population, it will be replaced by mp times the smallest (strictly) positive population in any region (default to 0.2)
- **pf**: ("gsm" or "gn") Determines space between map and boundary (default to 1.5)
- **sigma**: ("gsm" or "gn") Width of Gaussian blur to smoothen the density (default to 5)
- **center**: ("gsm" or "gn") either a character string (only possible choices are "centroid" or "point_on_surface") or a function. If the object is a function, it will be used to calculate the "center" of polygons; "point_on_surface" will use the function sf::st_point_on_surface while "centroid" (the default) will use sf::st_centroid.
- **verbose**: (all method) integer giving the verbosity level (default to 0, not verbose)
- **grid**: ("gsm" or "gn") boolean, if TRUE export the final grid from flow algorithm (default to TRUE). Setting to FALSE
- **check.ring.dir**: (all method) boolean, if TRUE controls polygons orientation (default to TRUE)
- **check.only**: (all method) boolean, if TRUE control only polygons orientation and no replacement is done (default to FALSE)

method the method to be used, can be one of the following: gsm or GastnerSeguyMore (default), gn or GastnerNewman, dcn or DougenikChrismanNiemeyer.

Value

a list to be processed by cartogramR
check_ring_dir

References


Examples

data(usa)
carto1 <- cartogramR(usa, "electors64", options=list(verb=1, L=256))
plot(carto1)

check_ring_dir

Polygon rings directions are checked and corrected if asked.

Description

Polygon ring are seen from above: exterior ring counter clockwise, holes clockwise

Usage

check_ring_dir(polygons, check.only = TRUE)

Arguments

polygons a sfc object which contains simple feature geometry of types POLYGON or MULTIPOLYGON
check.only a boolean which indicates if the function only checks the ring direction (check.only=TRUE) or checks and corrects the polygon direction (check.only=FALSE)

Value

Either a logical vector which indicates if line i of polygons is in the right direction (TRUE) or not or the corrected sfc object

Examples

data(usa)
all(check_ring_dir(sf::st_geometry(usa), check.only=TRUE))
dist_between_vertices  Analyse some of the grid options

Description
Analyse some of the grid options

Usage
dist_between_vertices(data)

Arguments
data a sf object to be used in cartogram.

Value
a 'dbv.cartogramR' object which is a data-table which contains distance between vertices ('dbv') and polygons names ('L1', 'L2', 'L3') inherited from [sf::st_coordinates]

Examples
data(usa)
dbv <- dist_between_vertices(data=usa)
summary(dbv)

france_dept  Map of the population of mainland France (year 2018)

Description
This data set is a basemap of mainland France with the population in 2018 (pop2018), the number of physicians in 2018 (n_physicians), the number of general practitioner in 2018 (n_gp) and the number of general practitioner for 100000 inhabitants in 2018 (n_gp_per100000) in each department (dept_name or id).

Usage
data(france_dept)

Format
A sf object containing 8 columns of data and the geometry Projected CRS: RGF93 / Lambert-93 (EPSG : 2154)
Source

https://www.data.gouv.fr/fr/datasets/admin-express/#_

References

• https://www.insee.fr/fr/statistiques/2012713#tableau-TCRD_004_tab1_departements
• https://www.insee.fr/fr/statistiques/2012677#tableau-TCRD_068_tab1_departements

france_rivers

| Map of french rivers of mainland France |

Description

This data set is a basemap of mainland french rivers (name or id).

Usage

data(france_rivers)

Format

A sf object containing 2 columns of data and the geometry Projected CRS: RGF93 / Lambert-93 (EPSG : 2154)

Source

https://geoservices.ign.fr/telechargement

from_coord_polygon

| Transform from coordinates system used in the polygons to coordinates system used in flow based cartogram |

Description

Apply the mapping from the coordinates system used in the polygons (characterised by the CRS) to the coordinates system used in flow based cartogram

Usage

from_coord_polygon(coord, carto)

Arguments

coord a vector of length 2 or a two columns matrix containing xy coordinates to transform
carto a cartogramR object
Value

a vector of length 2 or a two columns matrix containing xy coordinates in the coordinate systems of polygons used to build the cartogram

Examples

data(usa)
carto <- cartogramR(usa, "electors64")
from_coord_polygon(c(-0.007, -0.348), carto)

Description

Apply the deformation used to build a cartogram to a set of simple geometry coordinates. The resulting simple geometry object can be used to add geometry features on the cartogram.

Usage

geom_cartogramR(sfgeom, carto, verbose = FALSE)

Arguments

sfgeom a sf or a sfc object which contains simple feature geometry of types in the following POINT, MULTIPoint, LINESTRING, MULTILINESTRING, POLYGON, ‘MULTIPOLYGON
carto a cartogramR object
verbose a boolean object to set on verbose mode (default to FALSE)

Value

a sf or a sfc object which contains simple feature geometry transformed

Examples

data(usa)
carto <- cartogramR(usa, "electors64")
LA <- sf::st_sfc(sf::st_point(c(-118.243685, 34.052234)))
sf::st_crs(LA) <- 4326
moregeom <- geom_cartogramR(LA, carto)
plot(carto)
grid_analysis

Analyse some of the grid options

Description

Analyse some of the grid options

Usage

grid_analysis(data, gridpower2 = 8:11, pf = 1.5, verbose = FALSE)

Arguments

data a sf object to be used in cartogram.
gridpower2 a vector of exponent (to be raised at the power of 2) that gives the log2(size) of the grid (default to '8:11')
pf Determines space between map and boundary (default to 1.5)
verbose a boolean object to set on verbose mode (default to 'TRUE')

Value

a 'gridanalysis.cartogramR' object which is a matrix

Examples

data(usa)
ga <- grid_analysis(data=usa, gridpower2=4:8, verbose=TRUE)
summary(ga)

make_layer

Make a layer

Description

Create a sfc object containing final centers, original centers, centers displacement, original graticule or final graticule.

Usage

make_layer(
x,
  type = c("final_centers", "original_centers", "centers_translation",
            "final_graticule", "original_graticule")
)
Arguments

- **x**: a cartogramR object
- **type**: a character string giving the type of layer: - "final_centers": if method is dcn, `sf::st_centroid` is applied on deformed/cartogram region; if method is gsm or gn (ie flow based), initial "centers" are calculated and the cartogram deformation is applied on these "centers" giving the final_centers. - "original_centers" if method is dcn, `sf::st_centroid` is applied on original regions); if method is gsm or gn (ie flow based), initial "centers" are calculated using cartogramR center option see `cartogramR_options`. - "centers_translation" linestring giving the movement of centers due to the deformation used to have the cartogram - "final_graticule" (method gsm or gn) graticule obtained by the cartogram algorithm - "original_graticule" (method gsm or gn) graticule used by the cartogram algorithm

Value

- a sfc object

Description

Plot a cartogram object

Usage

```r
## S3 method for class 'cartogramR'
plot(x, ...)
```

Arguments

- **x**: a cartogram object
- **\dots**: arguments passed to or from other methods.

Value

No return value, called for side effects

Examples

```r
data(usa)
carto <- cartogramR(usa, "electors64")
plot(carto)
```
plot.dbv.cartogramR

Plot a dbv.cartogram object

Description

Plot a dbv.cartogram object

Usage

```r
## S3 method for class 'dbv.cartogramR'
plot(x, which = 1:2, ask = TRUE, key = TRUE, last = 10, probminx = 0.9, ...)```

Arguments

- `x`: a dbv.cartogram object
- `which`: if a subset of the plots is required, specify a subset of the numbers 1:2
- `ask`: logical; if TRUE, the user is asked before each plot, see `par(ask=.)`
- `key`: logical; if TRUE, a legend is drawn
- `last`: draw the density of distance between vertices for the last coordinates
- `probminx`: the sample quantiles (of distance between vertices) corresponding to the probability is used as a minimum of x-axis for the density plot (used only if `last` is NULL)
- `...`: arguments passed to or from other methods.

Details

The first plot is the density of distance between consecutive vertices by region. Only the upper quantiles are shown. The second plot is a barplot by region of the number of vertices divided by the perimeter of the region.

Value

No return value, called for side effects

Examples

```r
data(usa)
precarto <- precartogramR(usa, method="dcn")
plot(precarto)`
plot.gridanalysis.cartogramR

Plot a gridanalysis.cartogram object

Description

Plot a gridanalysis.cartogram object

Usage

## S3 method for class 'gridanalysis.cartogramR'
plot(
  x,  
  nthsmallest = 5, 
  redrawxaxis = TRUE, 
  type = "b", 
  xlab = NULL, 
  ylab = NULL, 
  ylim = c(0, 20), 
  ...
)

Arguments

x 
a gridanalysis.cartogram object

nthsmallest 
plot only the nthsmallest values among all polygons

redrawxaxis 
if TRUE redraw ticks and labels of x axe at grid size on log scale

type 
character string (length 1 vector) or vector of 1-character strings indicating the type of plot for each polygons, see graphics::matplot for all possible types.

xlab 
titles for x axe, as in graphics::matplot.

ylab 
titles for y axe, as in graphics::matplot.

ylim 
ranges of y axe, as in graphics::matplot.

Arguments passed to or from other methods.

Value

No return value, called for side effects

Examples

data(usa)
precarto <- precartogramR(usa, method="gsm", pf=1.2, verbose=TRUE)
plot(precarto)
precartogramR  Make a pre cartogram analysis

Description

Make a pre cartogram analysis

Usage

precartogramR(
  data,
             "DougenikChrismanNiemeyer"),
  gridpower2 = 8:11,
  pf = 1.5,
  verbose = FALSE
)

Arguments

data a sf object which contains at least two columns: obviously a geometry column (giving
the map) and a column which contains a count by region (leading to a density by region, density to be
equalized by deformation). Each row of data is a region and contains the simple feature geometry of
type POLYGON or MULTIPOLYGON. Polygon ring directions are not checked but exterior ring
must counter clockwise and holes clockwise (use option check_ring_dir of sf::st_read to
achieve the right orientation of ring direction on import or use check_ring_dir function)

method the method to be used, can be one of the following: gsm or GastnerSeguyMore (default),
gn or GastnerNewman, dcn or DougenikChrismanNiemeyer.

gridpower2 a vector of exponent (to be raised at the power of 2) that gives the log2(size) of
the grid (default to 8:11); meaningful for method gsm or GastnerSeguyMore (default),
gn or GastnerNewman

pf Determines space between map and boundary (default to 1.5); meaningful for
method gsm or GastnerSeguyMore (default), gn or GastnerNewman

verbose a boolean object to set on verbose mode (default to FALSE); meaningful for
method gsm or GastnerSeguyMore (default), gn or GastnerNewman

Value

either a dbv.cartogramR object (if method is dcn or DougenikChrismanNiemeyer) see dist_between_vertices
for details or a gridanalysis.cartogramR (if method is gsm or GastnerSeguyMore (default), gn
or GastnerNewman) see grid_analysis for details
References


Examples

```r
data(usa)
precarto <- precartogramR(usa)
plot(precarto)
summary(precarto)
```

print.cartogramR

`Print a cartogram object`

Description

Print a cartogram object

Usage

```r
## S3 method for class 'cartogramR'
print(x, ...)```

Arguments

- `x` a cartogramR object
- `...` arguments passed to or from other methods.

Value

No return value, called for side effects
print.summary.cartogramR

Print a summary of a cartogram object

Description

Print a summary of a cartogram object

Usage

## S3 method for class 'summary.cartogramR'
print(x, ...)

Arguments

x a summary.cartogramR object

\dots arguments passed to or from other methods. The following argument is available at this level: digits, the number of significant digits to use when printing.

Value

x.

Examples

data(usa)
carto <- cartogramR(usa, "electors64")
summary(carto)

residuals.cartogramR

Errors of a cartogram object

Description

Errors of a cartogram object

Usage

## S3 method for class 'cartogramR'
residuals(object, ...)

Examples
Arguments

object  a cartogramR object

\dots arguments passed to or from other methods. The following arguments are available:
- type; a character string giving the type of residuals (see details) - "relative error" - "absolute error" - "symmetric difference" - center ; a character string giving the type of center: - "point_on_surface" (st_point_on_surface applied on original and on deformed/cartogram region). - "deformed_center" (the center function, see cartogramR_options, is applied on region and this center follows the deformation giving the center on the deformed/cartogram region) - "centroid" (centroid of original and deformed/cartogram region). Can be abbreviated.

Details

The error vector contains the values of the differences between actual area of regions in the cartogram and the theoretical area (obtained with conservation of total area and constant density over region in the final cartogram)

Relative error are the error vector divided by the theoretical area

Symmetric difference are the symmetric difference between actual area of regions in the cartogram and the original area. Each region is scaled to have an area equal to 1 and centered around the chosen center.

Value

A numeric vector which contains for each region observed area minus theoretical area

Examples

```r
data(usa)
carto <- cartogramR(usa, "electors64")
residuals(carto)
```

---

**summary.cartogramR**  
**Summary of a cartogram object**

**Description**

Summary of a cartogram object
Usage

```r
## S3 method for class 'cartogramR'
summary(object, ...)  
```

Arguments

- `object`: a cartogramR object
- `\dots`: arguments passed to or from other methods. The following arguments are available:
  - `digits` integer, used for number formatting with `signif` if not specified (i.e., `missing`(), `signif`() will not be called anymore (since \texttt{R} >= 3.4.0, where the default has been changed to only round in the print and format methods).
  - `quantile.type` integer code used in `quantile(*, type=quantile.type)`.
  - `center` character string code used in `residuals.cartogramR`.

Value

A `summary.cartogramR` object: a list with the following components:

- `qrr`, the summary of absolute relative residuals
- `qres`, the summary of absolute residuals
- `qsymdiff`, the summary of all pairwise symmetric difference between two scaled (multi)polygons representative of two regions.

Examples

```r
data(usa)
carto <- cartogramR(usa, "electors64")
summary(carto)
```

Description

Summary of a \texttt{dbv.cartogram} object

Usage

```r
## S3 method for class 'dbv.cartogramR'
summary(object, ...)  
```
Arguments

object a dbv.cartogramR object
\dots arguments passed to or from other methods.

Value

a data-table which contains by region (L3)
• the sample quantiles corresponding to the probability 0.8, 0.85,...,1
• the total number of vertices divided by the perimeter of the region (the sum of all polygons
perimeter of the region, NbyPerim)

Examples

data(usa)
dbv <- dist_between_vertices(data=usa)
summary(dbv)

Description

Summary of a gridanalysis.cartogram object

Usage

## S3 method for class 'gridanalysis.cartogramR'
summary(object, ...)

Arguments

object a gridanalysis.cartogramR object
\dots arguments passed to or from other methods.

Value

A vector which indicate the grid size necessary to have more than steps grid points in each polygon

Examples

data(usa)
ga <- grid_analysis(data=usa, gridpower2=4:9)
summary(ga)
to_coord_polygon  
*Transform from coordinates system used in flow based cartogram to coordinates system used in the polygons*

**Description**

Apply the mapping from the coordinates system used in flow based cartogram to the coordinates system used in the polygons (characterised by the CRS)

**Usage**

```
to_coord_polygon(coord, carto)
```

**Arguments**

- `coord`: a vector of length 2 or a two columns matrix containing xy coordinates to transform
- `carto`: a cartogramR object

**Value**

a vector of length 2 or a two columns matrix containing xy coordinates in the coordinate systems of polygons used to build the cartogram

**Examples**

```
data(usa)
carto <- cartogramR(usa, "electors64")
to_coord_polygon(c(256,256), carto)
```

**usa**  
*Map of the number of electors in each state of the USA*

**Description**

This data set is a basemap of the conterminous USA with the number of electors in the 49 states from 1964 to 2020.

**Usage**

```
data(usa)
```
Format

A sf object containing 24 columns of data and the geometry. Projected CRS: US National Atlas Equal Area (EPSG:2163)
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