Package 'sandwich'

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Title sandwich: Spatial Interpolation Based on Spatial Stratified Heterogeneity

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Depends R (>= 3.5.0), sf, ggplot2, gridExtra, geodetector, dplyr, caret, lwgeom

Suggests rmarkdown,
knitr,
MASS

Description This package enables the implementation of Sandwich model-based mapping in R. It provides functions to output the summarized statistics, the interpolated surface, and the standard error and confidence interval maps.

License GPL (>= 2)

URL http://www.sssampling.cn/, https://github.com/linyuehzzz/sandwich_spatial_interpolator

BugReports https://github.com/linyuehzzz/sandwich_spatial_interpolator/issues

LazyData false

RoxygenNote 7.1.1

VignetteBuilder knitr

Encoding UTF-8

R topics documented:

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bc *Breast cancer incidence in mainland China*

Description

The bc dataset consists of three sf objects:

- bc.sampling: Breast cancer incidence at 271 sampling units in mainland China, which serves as the sampling layer.
- bc.ssh: A classification map with 20 strata that serves as a candidate SSH layer.
- bc.reporting: The administrative division of 32 provices in mainland China that served as the reporting layer.

Examples

```
library(sf)
library(ggplot2)
data("bc.sampling")
summary(bc.sampling$Incidence_)
ggplot(data=bc.sampling) + geom_sf(aes(color=Incidence_))
```

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geodetector.data *Prepare data for Geodetector*

Description

geodetector.data joins a candidate SSH layer to an existing layer.

Usage

```
geodetector.data(object, ssh.lyr, ssh.id, ssh.name=NULL)
```

Arguments

object	A POINT sf object to be joint. Its geometry should be consistent with the sampling layer, but it may have additional attributes from the SSH layer(s).
ssh.lyr	A POLYGON sf object used as the candidate SSH layer. Its strata ID will be linked to object.
ssh.id	A string denoting the attribute name of strata ID in the SSH layer.
ssh.name	A string denoting the new attribute name assigned to the strata ID in the output object. If NULL, the attribute name will be the same as that in the old SSH layer.

See Also

geodetector R package

`geodetector.factor` *Calculate Geodetector factor detector* q*-statistic*

Description

`geodetector.factor` calculates the factor detector *q*-statistic in the geographical detector model described by Wang et al. (2010). The *q*-statistic measures the SSH of the sampling attribute in terms of a given stratification, which can be used for the selection of an SSH layer for Sandwich model-based mapping.

Usage

```
geodetector.factor(object, y, x)
```

Arguments

`object`	A POINT `sf` object linking the attributes of the sampling layer and the strata ID in the SSH layer(s) generated from `geodetector.data`.
`y`	A `string` denoting the name of the explained variable (sampling attribute) in `object`.
`x`	A `string` denoting the name(s) of the explanatory variable(s) (stratification(s)) in `object`.

References

Wang, J. F., Li, X. H., Christakos, G., Liao, Y. L., Zhang, T., Gu, X., & Zheng, X. Y. (2010). Geographical detectors-based health risk assessment and its application in the neural tube defects study of the Heshun Region, China. *International Journal of Geographical Information Science*, 24(1), 107-127. doi:10.1080/13658810802443457

See Also

geodetector R package

`geodetector.interaction`
Calculate Geodetector interaction detector

Description

`geodetector.interaction` calculates the factor detector in the geographical detector model described by Wang et al. (2010). The interactive effects indicate whether a combination of two stratifications enhances the SSH of the sampling attribute.

Usage

```
geodetector.interaction(object, y, x)
```

Arguments

object	A POINT sf object linking the attributes of the sampling layer and the strata ID in the SSH layer(s) generated from geodetector.data.
y	A string denoting the name of the explained variable in object.
x	A string denoting the name(s) of the explanatory variable(s) in object.

References

Wang, J. F., Li, X. H., Christakos, G., Liao, Y. L., Zhang, T., Gu, X., & Zheng, X. Y. (2010). Geographical detectors-based health risk assessment and its application in the neural tube defects study of the Heshun Region, China. *International Journal of Geographical Information Science*, 24(1), 107-127. doi:10.1080/13658810802443457

See Also

geodetector R package

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hs *Heshun human population dataset*

Description

The hs dataset consists of four sf objects:

- hs.sampling: Human population of 326 sampling villages within the Heshun region, China, which serves as the sampling layer.
- hs.ssh: A zonation map with 5 strata that serves as a candidate SSH layer.
- hs.ssh2: A zonation map with 6 strata that serves as another candidate SSH layer.
- hs.reporting: The administrative division of 10 towns in Heshun county that served as the reporting layer.

References

Li, L., Wang, J., & Wu, J. (2012). A spatial model to predict the incidence of neural tube defects. *BMC Public Health*, 12(1), 951. doi:10.1186/1471-2458-12-951

Examples

```
library(sf)
library(ggplot2)
data("hs.sampling")
summary(hs.sampling$Population)
ggplot(data=hs.sampling) + geom_sf(aes(color=Population))
```

jl *Jilin rodent density dataset*

Description

The `jl` dataset consists of four `sf` objects:

- `jl.sampling`: Rodent density at 627 sampling quadrats in Jilin, China, which serves as the sampling layer.
- `jl.ssh`: A classification map with 8 strata that serves as a candidate SSH layer.
- `jl.ssh2`: A zonation map with 11 strata that serves as another candidate SSH layer.
- `jl.reporting`: The administrative division of 10 counties in Jilin that served as the reporting layer.

References

Liu, T., Wang, J., Xu, C., Ma, J., Zhang, H., & Xu, C. (2018). Sandwich mapping of rodent density in Jilin Province, China. *Journal of Geographical Sciences*, 28(4), 445-458.. doi:10.1007/s11442-018-1483-z

Examples

```
library(sf)
library(ggplot2)
data("jl.sampling")
summary(jl.sampling$Shushu)
ggplot(data=jl.sampling) + geom_sf(aes(color=Shushu))
```

load.shp *Load shapefile into* `sf`

Description

`load.shp` converts a shapefile into a `sf` object.

Usage

```
load.shp(path, file)
```

Arguments

`path`	Directory of the shapefile.
`file`	Name of the shapefile, minus extension (.shp).

plot.ci *Plot confidence interval of the Sandwich estimates*

Description

plot.ci plots the lower and upper bounds of the confidence interval of estimated mean value for each reporting unit.

Usage

```
plot.ci(object)
```

Arguments

object	An sf object generated from the sandwich.confint function.

plot.mean *Plot Sandwich estimates*

Description

plot.mean plots the mean value of an attribute for each reporting unit estimated by the Sandwich model.

Usage

```
plot.mean(object)
```

Arguments

object	An sf object generated from the sandwich function.

References

Wang, J. F., Haining, R., Liu, T. J., Li, L. F., & Jiang, C. S. (2013). Sandwich estimation for multi-unit reporting on a stratified heterogeneous surface. *Environment and Planning A*, 45(10), 2515-2534. doi:10.1068/a44710

plot.se *Plot standard error of the Sandwich estimates*

Description

plot.se plots the standard error of estimated mean value for each reporting unit.

Usage

```
plot.se(object)
```

Arguments

object	An sf object generated from the sandwich function.

References

Wang, J. F., Haining, R., Liu, T. J., Li, L. F., & Jiang, C. S. (2013). Sandwich estimation for multi-unit reporting on a stratified heterogeneous surface. *Environment and Planning A*, 45(10), 2515-2534. doi:10.1068/a44710

sandwich sandwich*: Spatial Interpolation Based on Spatial Stratified Heterogeneity*

Description

The package sandwich provides tools to interpolate a spatially stratified heterogeneous population with high accuracy, even when its spatial autocorrelation is weak. These tools allow the calculation of critical summarized statistics such as Geodetector q. They also enable the visualization of the interpolated surface as well as the standard error and confidence interval maps.

Author(s)

Yue Lin, Chengdong Xu, and Jinfeng Wang

References

Wang, J. F., Haining, R., Liu, T. J., Li, L. F., & Jiang, C. S. (2013). Sandwich estimation for multi-unit reporting on a stratified heterogeneous surface. *Environment and Planning A*, 45(10), 2515-2534. doi:10.1068/a44710

sandwich.confint *Calculate confidence interval of the Sandwich estimates*

Description

sandwich.confint calculates the confidence interval of estimated mean value for each reporting unit.

Usage

```
sandwich.confint(object, level=.95)
```

Arguments

object	An sf object generated from the sandwich.model function.
level	The confidence level required. By default, level = .95.

sandwich.cv *Perform* k*-fold cross validation*

Description

sandwich.cv perfoms *k*-fold cross validation to evaluate the overall model accuracy and outputs the average root mean square error (RMSE).

Usage

```
sandwich.cv(sampling.lyr, ssh.lyr, reporting.lyr, sampling.attr, k=10)
```

Arguments

sampling.lyr	A POINT sf object used as the sampling layer. It should contain an attribute that is to be interpolated.
ssh.lyr	A POLYGON sf object used as the SSH layer.
reporting.lyr	A POLYGON sf object used as the reporting layer.
sampling.attr	A string denoting the name of the attribute in the sampling layer to be interpolated.
k	The number of folds (k > 1). By default, k = 10.

`sandwich.model` *Perform Sandwich model-based mapping*

Description

`sandwich.model` estimate the mean value of an attribute and its standard error for each reporting unit using the Sandwich method documented by Wang et al. (2013).

Usage

```
sandwich(sampling.lyr, ssh.lyr, reporting.lyr, sampling.attr)
```

Arguments

`sampling.lyr`	A POINT `sf` object used as the sampling layer. It should contain an attribute that is to be interpolated.
`ssh.lyr`	A POLYGON `sf` object used as the SSH layer.
`reporting.lyr`	A POLYGON `sf` object used as the reporting layer.
`sampling.attr`	A `string` denoting the name of the attribute in the sampling layer to be interpolated.

References

Wang, J. F., Haining, R., Liu, T. J., Li, L. F., & Jiang, C. S. (2013). Sandwich estimation for multi-unit reporting on a stratified heterogeneous surface. *Environment and Planning A*, 45(10), 2515-2534. doi:10.1068/a44710

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