Package 'scgwr'

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Type Package

Title Scalable Geographically Weighted Regression

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Description Fast and regularized version of GWR for large dataset, detailed in Murakami, Tsutsumida, Yoshida, Nakaya, and Lu (2019) <doi:10.48550/arXiv.1905.00266>.

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Imports FNN, spData, sp, dplyr, parallel, optimParallel

NeedsCompilation no

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Contents

`predict0` *Spatial prediction using the scalable GWR model*

Description

This function predicts explained variables and spatially varying coefficients at unobserved sites using the scalable GWR model.

Usage

```
predict0( mod, coords0, x0 = NULL )
```

Arguments

mod	Output from the scgwr function
coords0	Matrix of spatial point coordinates at predicted sites (N0 x 2)
x0	Matrix of explanatory variables at predicted sites (N0 x K). If NULL, explained variables are not predicted (only spatially varying coefficients are predicted). Default is NULL

Value

pred	Vector of predicted values (N0 x 1)
b	Matrix of estimated coefficients (N0 x K)
bse	Matrix of the standard errors for the coefficients (N0 x k)
t	Matrix of the t-values for the coefficients (N0 x K)
p	Matrix of the p-values for the coefficients (N0 x K)

Examples

```
require(spData)
data(boston)

id_obs  <-sample(dim(boston.c)[1],400)

######################### data at observed sites
y       <- log(boston.c[id_obs,"MEDV"])
x       <- boston.c[id_obs, c("CRIM", "INDUS","ZN","NOX","AGE")]
coords  <- boston.c[id_obs , c("LON", "LAT") ]

######################### data at predicted sites
x0      <- boston.c[-id_obs, c("CRIM", "INDUS","ZN","NOX", "AGE")]
coords0 <- boston.c[-id_obs , c("LON", "LAT") ]

mod     <- scgwr( coords = coords, y = y, x = x )
pred0   <- predict0( mod=mod, coords0=coords0, x0=x0)

pred    <- pred0$pred # predicted value
b       <- pred0$b    # spatially varying coefficients
b[1:5,]

bse     <- pred0$bse  # standard error of the coefficients
bt      <- pred0$t    # t-values
bp      <- pred0$p    # p-values
```

scgwr *Scalable Geographically Weighted Regression*

Description

This function estimates a scalable geographically weighted regression (GWR) model. See scgwr_p for parallel implementqtion of the model for very large samples.

Usage

```
scgwr( coords, y, x = NULL, knn = 100, kernel = "gau",
       p = 4, approach = "CV", nsamp = NULL)
```

Arguments

coords	Matrix of spatial point coordinates (N x 2)
y	Vector of explained variables (N x 1)
x	Matrix of explanatory variables (N x K). Default is NULL
knn	Number of nearest-neighbors being geographically weighted. Default is 100. Larger knn is better for larger samples (see Murakami er al., 2019)
kernel	Kernel to model spatial heterogeneity. Gaussian kernel ("gau") and exponential kernel ("exp") are available
p	Degree of the polynomial to approximate the kernel function. Default is 4
approach	If "CV", leave-one-out cross-validation is used for the model calibration. If "AICc", the corrected Akaike Information Criterion is minimized for the calibation. Default is "CV"
nsamp	Number of samples used to approximate the cross-validation. The samples are randomly selected. If the value is large enough (e.g., 10,000), error due to the random sampling is quite small owing to the central limit theorem. The value must be smaller than the sample size. Default is NULL

Value

b	Matrix of estimated coefficients (N x K)
bse	Matrix of the standard errors for the coefficients (N x k)
t	Matrix of the t-values for the coefficients (N x K)
p	Matrix of the p-values for the coefficients (N x K)
par	Estimated model parameters includeing a scale parameter and a shrinkage parameter if penalty = TRUE (see Murakami et al., 2018)
e	Error statistics. It includes sum of squared errors (SSE), residual standard error (resid_SE), R-squared (R2), adjusted R2 (adjR2), log-likelihood (logLik), corrected Akaike information criterion (AICc), and the cross-validation (CV) score measured by root mean squared error (RMSE) (CV_score(RMSE))

pred	Vector of predicted values (N x 1)
resid	Vector of residuals (N x 1)
other	Other objects internally used

References

Murakami, D., Tsutsumida, N., Yoshida, T., Nakaya, T., and Lu, B. (2019) Scalable GWR: A linear-time algorithm for large-scale geographically weighted regression with polynomial kernels. <arXiv:1905.00266>.

See Also

scgwr_p, predict0

Examples

```
require( spData )
data( boston )
coords <- boston.c[, c("LON", "LAT") ]
y      <- log(boston.c[,"MEDV"])
x      <- boston.c[, c("CRIM", "ZN", "INDUS", "CHAS", "AGE")]
res    <- scgwr( coords = coords, y = y, x)
res
```

---

scgwr_p *Parallel implementation of scalable geographically weighted regression*

Description

Parallel implementation of scalable geographically weighted regression for large samples

Usage

```
scgwr_p( coords, y, x = NULL, knn = 100, kernel = "gau",
       p = 4, approach = "CV", nsamp = NULL, cl = NULL)
```

Arguments

coords	Matrix of spatial point coordinates (N x 2)
y	Vector of explained variables (N x 1)
x	Matrix of explanatory variables (N x K). Default is NULL
knn	Number of nearest-neighbors being geographically weighted. Default is 100. Larger knn is better for larger samples (see Murakami er al., 2019)
kernel	Kernel to model spatial heterogeneity. Gaussian kernel ("gau") and exponential kernel ("exp") are available

p	Degree of the polynomial to approximate the kernel function. Default is 4
approach	If "CV", leave-one-out cross-validation is used for the model calibration. If "AICc", the corrected Akaike Information Criterion is minimized for the calibation. Default is "CV"
nsamp	Number of samples used to approximate the cross-validation. The samples are randomly selected. If the value is large enough (e.g., 10,000), error due to the sampling is quite small owing to the central limit theorem. The value must be smaller than the sample size. Default is NULL
cl	Number of cores used for the parallel computation. If cl = NULL, which is the default, the number of available cores is detected and used

Value

b	Matrix of estimated coefficients (N x K)
bse	Matrix of the standard errors for the coefficients (N x k)
t	Matrix of the t-values for the coefficients (N x K)
p	Matrix of the p-values for the coefficients (N x K)
par	Estimated model parameters includeing a scale parameter and a shrinkage parameter if penalty = TRUE (see Murakami et al., 2018)
e	Error statistics. It includes sum of squared errors (SSE), residual standard error (resid_SE), R-squared (R2), adjusted R2 (adjR2), log-likelihood (logLik), corrected Akaike information criterion (AICc), and the cross-validation (CV) score measured by root mean squared error (RMSE) (CV_score(RMSE))
pred	Vector of predicted values (N x 1)
resid	Vector of residuals (N x 1)
other	Other objects internally used

References

Murakami, D., Tsutsumida, N., Yoshida, T., Nakaya, T., and Lu, B. (2019) Scalable GWR: A linear-time algorithm for large-scale geographically weighted regression with polynomial kernels. <arXiv:1905.00266>.

See Also

scgwr, predict0

Examples

```
# require(spData);require(sp)
# data(house)
# dat  <- data.frame(coordinates(house), house@data[,c("price","age","rooms","beds","syear")])
# coords<- dat[ ,c("long","lat")]
# y     <- log(dat[,"price"])
# x     <- dat[,c("age","rooms","beds","syear")]

# Parallel estimation
```

```
# res1  <- scgwr_p( coords = coords, y = y, x = x )
# res1

# Parallel estimation + Approximate cross-validation using 10000 samples
# res2  <- scgwr_p( coords = coords, y = y, x = x, nsamp = 10000 )
# res2
```

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