Package 'geoFourierFDA'

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Title Ordinary Functional Kriging Using Fourier Smoothing and Gaussian Quadrature

Version 0.1.0

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Description Implementation of the ordinary functional kriging method proposed by Giraldo (2011) <doi:10.1007/s10651-010-0143-y>. This implements an alternative method to estimate the trace-variogram using Fourier Smoothing and Gaussian Quadrature.

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Depends R (>= 3.5.0)

Encoding UTF-8

LazyData true

RoxygenNote 7.1.2

LinkingTo Rcpp, RcppArmadillo

Imports Rcpp, stats, magrittr, orthopolynom

NeedsCompilation yes

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R topics documented:

canada *Time series from 35 weather stations of Canada.*

Description

A dataset containing time series from 15 weather stations (The Pas station and more 34 stations to estimate the temperature curve at the Pas station). This dataset is present in the `fda` package.

Usage

```
data(canada)
```

Format

A list with four matrices:

m_data A matrix with 14 columns where each column is a wheather station

m_coord A matrix with 14 rows where each row is a weather station

ThePas_coord Coordinate of the The Pas station

ThePas_ts Observed time series of the station The Pas

Source

https://weather.gc.ca

References

J. O. Ramsay, Spencer Graves and Giles Hooker (2020). `fda`: Functional Data Analysis. R package version 5.1.9. https://CRAN.R-project.org/package=fda

coef_fourier *This function computes minimum square estimates for Fourier coefficients.*

Description

This function computes minimum square estimates for Fourier coefficients.

Usage

```
coef_fourier(f, m)
```

Arguments

`f`	A time series to be smoothed.
`m`	Order of the Fourier polynomial. Default value is computed using the Sturge's rule.

Value

A vector with the fourier coefficients.

Examples

```
data(canada)

coef_fourier(canada$ThePas_ts)
```

`fourier_b` *This function the smoothed curve*

Description

This function the smoothed curve

Usage

```
fourier_b(coef, x)
```

Arguments

`coef`	Fourier coefficients.
`x`	a time series to evaluate the smoothed curve.

Value

a time series with the smoothed curve.

Examples

```
data(canada)

coefs <- coef_fourier(canada$ThePas_ts)
y_hat <- fourier_b(coefs)
```

geo_fda *Geostatistical estimates for function-valued data.*

Description

geo_fda finds the ordinary kriging estimate for sptial functional data using the model proposed by Giraldo(2011).

Usage

```
geo_fda(
  m_data,
  m_coord,
  new_coord,
  m,
  n_quad = 20,
  t = seq(from = -pi, to = pi, length.out = 1000)
)
```

Arguments

m_data	a matrix where each column is a time series in a location
m_coord	a matrix with coordinates (first column is latitude and second column longitude)
new_coord	a vector with a new coordinate (first column is latitude and second longitude)
m	order of the Fourier polynomial
n_quad	a scalar with number of quadrature points. Default value nquad = 20.
t	a vector with points to evaluate from $-\pi$ to π. Default t = seq(from = -pi,to = pi,length.out = 1e+3).

Details

geo_fda is similar to model proposed by *giraldo2011ordinary*. The mais difference is we have used gauss-legendre quadrature to estimate the trace-variogram. Using gauss-legendre qudrature gives estimates with smaller mean square error than the trace-variogram estimates from Giraldo(2011).

For now, we have used Fourier's series to smooth the time series.

Value

a list with three components

curve estimate curve at t points

lambda weights in the linear combination in the functional kriging

x points where the curve was evaluated

References

Giraldo, R., Delicado, P., & Mateu, J. (2011). Ordinary kriging for function-valued spatial data. *Environmental and Ecological Statistics*, 18(3), 411-426.

Giraldo, R., Mateu, J., & Delicado, P. (2012). geofd: an R package for function-valued geostatistical prediction. *Revista Colombiana de Estadística*, 35(3), 385-407.

See Also

coef_fourier, fourier_b

Examples

```
data(canada)

y_hat <- geo_fda(canada$m_data, canada$m_coord, canada$ThePas_coord,
n_quad = 2)
```

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geo_model *EStimates the parameters of the exponential model.*

Description

geo_model finds the maximum likelihood estimate for the parameters in the geostatistical exponential model.

Usage

```
geo_model(v_data, m_coord)
```

Arguments

v_data	a numeric vector with the data
m_coord	a matrix with two column. The first column must be the latitude and the second column must be the longitude.

Value

a list with components

mean mean of the process

phi range of exponential model

sigmasq total sill of exponential model

convergence convergence as specified in the function nlminb

Examples

```
data(canada)
v_data <- canada$m_data[1, ]
geo_model(v_data, canada$m_coord)
```

`logLik` *Log-likehood function multiplied by -1.*

Description

This function computes the likelihood function used at `geo_model`.

Arguments

`mDist`	distance matris;
`s2`	variance from the covariance model;
`phi`	variance from the covariance model;
`vDiff`	column vector of data (subtracted the mean vector)

Value

log-likelihood value multiplied by -1.

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