Package ‘geoFKF’

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Title Kriging Method for Spatial Functional Data
Version 0.1.0
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Description A Kriging method for functional datasets with spatial dependency.
This functional Kriging method avoids the need to estimate the
trace-variogram, and the curve is estimated by minimizing a quadratic
form. The curves in the functional dataset are smoothed using Fourier
series. The functional Kriging of this package is a modification of the
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**coef_fourier**

*Computing coefficients Fourier.*

**Description**

This function computes minimum square estimates for Fourier coefficients.

**Usage**

```r
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**

```r
x <- seq(from = -pi, to = pi, by = 0.01)
y <- x^2 + rnorm(length(x), sd = 0.1)
v_coef <- coef_fourier(y)
```

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**datasetCanada**

*Temperature datasets from Canada.*

**Description**

Temperature time series from 35 weather stations from Canada. This dataset is a classic one and was used in famous package fda. We have made a few changes in this dataset.

**Usage**

```r
data("datasetCanada")
```

**Format**

A list with two entries: `m_coord` and `m_data`.

- `m_coord` a tibble with latitude, longitude and the name of stations.
- `m_data` a tibble where each column is the time series from a weather station.
fourier_b

Source
the CanadianWeather dataset from the \texttt{R} package \texttt{fda}.

\texttt{fourier_b} \hspace{1cm} \textit{Smoothed curve in Fourier Series.}

Description
This function computes the smoothed curve using Fourier coefficients.

Usage
\texttt{fourier\_b(coef, x)}

Arguments
\begin{itemize}
  \item \texttt{coef} \hspace{1cm} Fourier coefficients.
  \item \texttt{x} \hspace{1cm} a time series to evaluate the smoothed curve.
\end{itemize}

Value
a time series with the smoothed curve.

Examples
\begin{verbatim}
v_coef <- rnorm(23)
fourier_b(v_coef)
\end{verbatim}

geo_fkf \hspace{1cm} \textit{Kriging method for Spatial Functional Data.}

Description
\texttt{geo_fkf} implements the kriging method for spatial functional datasets.

Usage
\texttt{geo_fkf(m\_data, m\_coord, new\_loc, p, t = seq(from = -pi, to = pi, by = 0.01))}

Arguments
\begin{itemize}
  \item \texttt{m\_data} \hspace{1cm} a tibble where each column or variable is data from a station
  \item \texttt{m\_coord} \hspace{1cm} a tibble with two columns: latitude and longitude
  \item \texttt{new\_loc} \hspace{1cm} a tible with one observation, where the columns or variables are latitude and longitude
  \item \texttt{p} \hspace{1cm} order in the Fourier Polynomial
  \item \texttt{t} \hspace{1cm} a time series with values belonging to \([-\pi, \pi]\) to evaluate the estimate curve
\end{itemize}
Value

a list with three entries: estimates, Theta and cov_params

estimates the estimate curve

Theta weights (matrices) of the linear combination

cov_params estimate $\sigma^2$, $\phi$ and $\rho$

Examples

data("datasetCanada")

m_data <- as.matrix(datasetCanada$m_data)
m_coord <- as.matrix(datasetCanada$m_coord[, 1:2])
pos <- sample.int(nrow(m_coord), 1)
log_pos <- !(seq_len(nrow(m_coord)) %in% pos)
new_loc <- m_coord[pos, ]
m_coord <- m_coord[log_pos, ]
m_data <- m_data[, log_pos]

geo_fkf(m_data, m_coord, new_loc)

logLikMultiNorm Log likelihood function for multivariate normal with spatial dependency.

Description

Log likelihood function for multivariate normal with spatial dependency.

Arguments

mCoef coefficient matrix. Each column is the coefficient from a curve;
mDist distance matrix;
s2 variance from the covariance model;
phi variance from the covariance model;
rho variance from the covariance model;
Description

This function maximum likelihood estimate for $\sigma^2$, $\phi$ and $\rho$ in the random field model for the covariance.

Usage

log_lik_rf(m_coef, m_coord)

Arguments

m_coef Matrix where each column is an observed vector
m_coord Matrix where each observation contains the latitude and longitude

Value

Return a list with

par A vector with the estimates of $\sigma^2$, $\phi$ and $\rho$.
m_cov A matrix of covariances of the estimates.

Examples

data("datasetCanada")

m_data <- as.matrix(datasetCanada$m_data)
m_coord <- as.matrix(datasetCanada$m_coord[, 1:2])

p <- ceiling(1 + log2(nrow(m_data)))
m_coef <- sapply(seq_len(nrow(m_coord)), function(i) {
  coef_fourier(m_data[, i], p)
})

log_lik_rf(m_coef, m_coord)
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