Package 'flowfield'

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Type Package

Title Forecasts future values of a univariate time series.

Version 1.0

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Suggests SemiPar

Description Flow field forecasting draws information from an interpolated flow field of the observed time series to incrementally build a forecast.

License GPL-3

NeedsCompilation no

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`ffplot` *Flow field forecast plot*

Description

Plots the original data, the penalized spline regression, the forecast values and error bands.

Usage

```
ffplot(t, y, skeleton, fcast, std.error)
```

Arguments

`t`	time series observation times
`y`	time series response values
`skeleton`	data skeleton from penalized spline regression
`fcast`	forecast values
`std.error`	forecast errors

Value

Returns no values. This function returns a plot of the time series, the penalized spline regression, the forecast values and prediction bands.

Author(s)

Kyle A. Caudle

References

Frey, MR and Caudle, KA "Flow field forecasting for univariate time series," Statistical Analysis and Data Mining, 2013.

`Flow Field Forecasting`
Forecast of a univariate time series Flow Field Forecasting

Description

Flow field forecasting draws information from an interpolated flow field of the observed time series to incrementally build a forecast. The time series need not have uniformly spaced observations. Flow field forecasting works best on relatively long time series (i.e. > 1000 observations) where forecasts must be made autonomously.

Details

Package:	Flow Field Forecasting
Type:	Package
Version:	1.0
Date:	2013-11-22
License:	GPL-3

Time series response values should be loaded into a numeric vector. Since flow field forecasting accepts unequally spaced observations, a second vector of observation times is also required.

Flow field forecasting uses penalized spline regression to make a historical data skeleton in order to summarize the data prior to building the forecast. Forcasts are made at time steps equivalent to the knot spacing in the data skeleton. For forecasts at times between knots we recommend doing a linear interpolation.

Author(s)

Kyle A. Caudle

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References

1. Frey, MR and Caudle, KA "Flow field forecasting for univariate time series," Statistical Analysis and Data Mining, 2013

2. C. E. Rasmussen and C. K. I. Williams, Gaussian Processes for Machine Learning, Cambridge, MA, MIT Press, 2006

3. D. Ruppert, M. P. Wand and R. J. Carroll, Semiparametric Regression. New York, NY: Cambidge University Press, 2003.

Examples

```
library(SemiPar)
data(lidar)

t <- lidar$range
y <- lidar$logratio

steps <- 10 # number of forecast steps (steps must be 10 or less)
flowfield(t,y,steps,TRUE)
```

`flowfield` *Flow Field Forecasting*

Description

Flow field forecasting draws information from an interpolated flow field of the observed time series to incrementally build a forecast. The time series need not have uniformly spaced observations. Flow field forecasting works best on relatively long time series (i.e. > 1000 observations) where forecasts must be made autonomously.

Usage

```
flowfield(t,y,steps,plot)
```

Arguments

t	A vector of time series observation times.
y	A vector of time series response values
steps	Number of steps to forecast. Forecasts > 10 steps are not allowed, a warning will occur. Forecasts occur in knot intervals of the penalized spline regression. Knots are evenly spaced within the range of data appoximately one knot for every 10 data points.
plot	If a plot is required, set plot = TRUE otherwise set plot = FALSE

Value

This function returns the flow field forecasts and the associated prediction errors. A plot of the original data, the penalized spline regression, the forecast values and the prediction bands is also provided upon request.

Note

If data is too sparse, a WARNING will be given to the issue to indicate that forecasts may be inaccurate.

Author(s)

Kyle A. Caudle

References

1. Frey, MR and Caudle, KA "Flow field forecasting for univariate time series," Statistical Analysis and Data Mining, 2013.

2. C. E. Rasmussen and C. K. I. Williams, Gaussian Processes for Machine Learning, Cambridge, MA, MIT Press, 2006.

3. D. Ruppert, M. P. Wand and R. J. Carroll, Semiparametric Regression. New York, NY: Cambidge University Press, 2003.

Examples

```
library(SemiPar)
data(lidar)

t <- lidar$range
y <- lidar$logratio

steps <- 10 # number of forecast steps (steps must be 10 or less)
flowfield(t,y,steps,TRUE)
```

forecast *forecast*

Description

Performs the flow field forecast give a historical data skeleton from the penalized spline regression.

Usage

```
forecast(skeleton, steps)
```

Arguments

skeleton	data skeleton from penalized spline regression
steps	Number of steps to forecast. Forecasts occur in knot intervals of the penalized spline regression. Knots are evenly spaced within the range of data appoximately one knot for every 10 data points.

Value

Returns the forecast values.

Note

If data is too sparse, a WARNING will be given to the issue to indicate that forecasts may be inaccurate.

Author(s)

Kyle A. Caudle

References

Frey, MR and Caudle, KA "Flow field forecasting for univariate time series," Statistical Analysis and Data Mining, 2013.

GCV *GCV*

Description

Evaluates the generalized cross generalization criterion for a specific value of lambda.

Usage

```
GCV(lambda,y,x,d)
```

Arguments

lambda	lambda value to evaulate the GCV criterion at
y	Time series response values.
x	Design matrix from the penalized spline regression.
d	Diagonal matrix used to constrain the linear model. This is a type of Ridge regression.

Value

Returns the GCV value for a specific value of lambda and an input into the optimize function in order to minimize this function.

Author(s)

Kyle A. Caudle

References

D. Ruppert, M. P. Wand and R. J. Carroll, Semiparametric Regression. New York, NY: Cambidge University Press, 2003.

gpr *gpr*

Description

Interpolates the penalized regression skeleton using Gaussian process regression.

Usage

```
gpr(h, rec3.sd, rec3.delta, ssd, sdelta, responses)
```

Arguments

h	History space. Current version uses the curent and last 2 levels of the systematically determined component (SDC) and the previous 3 forward response derivatives.
rec3.sd	Most recent SDC values in the history space.
rec3.delta	Most recent forward response derivatives in the history spac.
ssd	Standard devation of the SDCs.
sdelta	Standard devation of the forward response derivatives.
responses	All values of the forward response derivatives in the history space.

Value

Returns the GPR interpolated value by comparing the current history to the entire history space.

Author(s)

Kyle A. Caudle

References

Frey, MR and Caudle, KA "Flow field forecasting for univariate time series," Statistical Analysis and Data Mining, 2013.

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psr *psr*

Description

Constructs a penalized spline regression of the historical time series data to be used in flow field forcasting.

Usage

```
psr(t, y)
```

Arguments

t	Time series observation times.
y	Time series response values.

Value

Returns the penalized spline regression data skeleton.

Author(s)

Kyle A. Caudle

References

D. Ruppert, M. P. Wand and R. J. Carroll, Semiparametric Regression. New York, NY: Cambidge University Press, 2003.

`smoothp` *smoothp*

Description

Determines the smoothing paramter in the penalized spline regression.

Usage

```
smoothp(t, y, x, d)
```

Arguments

`t`	Time series observation times.
`y`	Time series response values.
`x`	Design matrix from the penalized spline regression.
`d`	Diagonal matrix used to constrain the linear model. This is a type of Ridge regression.

Value

Returns the smoothing parameter lambda for the penalized spline regression.

Author(s)

Kyle A. Caudle

References

D. Ruppert, M. P. Wand and R. J. Carroll, Semiparametric Regression. New York, NY: Cambidge University Press, 2003.

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