Package 'npregfast'

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Type Package

Title Nonparametric Estimation of Regression Models with Factor-By-Curve Interactions

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Description A method for obtain nonparametric estimates of regression models with or without factor-by-curve interactions using local linear kernel smoothers. Additionally, a parametric model (allometric model) can be estimated.

URL

BugReports http://github.com/sestelo/npregfast/issues

Depends R (>= 3.2.0)

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LazyData true

Imports

R topics documented:

`allotest` *Bootstrap based test for testing an allometric model*

Description

Bootstrap-based procedure that test whether the data can be modelled by an allometric model.

Usage

```
allotest(formula, data = data, nboot = 500, kbin = 200, seed = NULL)
```

Arguments

`formula`	An object of class `formula`: a sympbolic description of the model to be fitted.
`data`	A data frame or matrix containing the model response variable and covariates required by the `formula`.
`nboot`	Number of bootstrap repeats.
`kbin`	Number of binning nodes over which the function is to be estimated.
`seed`	Seed to be used in the bootstrap procedure.

Details

In order to facilitate the choice of a model appropriate to the data while at the same time endeavouring to minimise the loss of information, a bootstrap-based procedure, that test whether the data can be modelled by an allometric model, was developed. Therefore, `allotest` tests the null hypothesis of an allometric model taking into account the logarithm of the original variable ($X^* = log(X)$ and $Y^* = log(Y)$).

Based on a general model of the type

$$Y^* = m(X^*) + \varepsilon$$

the aim here is to test the null hypothesis of an allometric model

$$H_0 = m(x^*) = a^* + b^* x^*$$

$vs.$ general hypothesis H_1, with m being an unknown nonparametric function; or analogously,

$$H_1 : m(x^*) = a^* + b^* x^* + g(x^*)$$

with $g(x^*)$ being an unknown function not equal to zero.

To implement this test we have used the wild bootstrap.

Value

An object is returned with the following elements:

`statistic`	the value of the test statistic.
`value`	the p-value of the test.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Sestelo, M. and Roca-Pardinas, J. (2011). A new approach to estimation of length-weight relationship of $Pollicipes\ pollicipes$ (Gmelin, 1789) on the Atlantic coast of Galicia (Northwest Spain): some aspects of its biology and management. Journal of Shellfish Research, 30 (3), 939–948.

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Examples

```
library(npregfast)
data(barnacle)
allotest(DW ~ RC, data = barnacle)
allotest(DW ~ RC : F, data = barnacle)
```

`barnacle` *Barnacle dataset.*

Description

Barnacle dataset.

Usage

```
barnacle
```

Format

`barnacle` is a data frame with 3 variables (columns).

F Factor indicating...

RC Rostro-carinal lenght (in mm).

DW Dry weight (in g.)

Examples

```
data(barnacle)
head(barnacle)
```

`critical` *Critical points of the regression function*

Description

This function draws inference about some some critical point in the support of X which is associated with some features of the regression function (e.g., minimum, maximum or inflection point which indicate changes in the sign of curvature). Returns the value of the covariate `x` which maximizes the estimate of the function, which maximizes the first derivative and which equals the second derivative to zero, for each level of the factor.

Usage

```
critical(model, der = NULL)
```

Arguments

`model`	Parametric or nonparametric regression out obtained by `frfast` function.
`der`	Number which determines any inference process. By default `der` is `NULL`. If this term is `0`, the calculation is for the point which maximize the estimate. If it is `1` it is designed for the first derivative and if it is `2`, it returns the point which equals the second derivative to zero.

Value

An object is returned with the following elements:

`Estimation`	`x` value which maximize the regression function with their 95% confidence intervals (for each level).
`First_der`	`x` value which maximize the first derivative with their 95% confidence intervals (for each level).
`Second_der`	`x` value which equals the second derivative to zero with their 95% confidence intervals (for each level).

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Examples

```
library(npregfast)
data(barnacle)

fit <- frfast(DW ~ RC, data = barnacle) # without interactions
critical(fit)
critical(fit, der = 0)
critical(fit, der = 1)
critical(fit, der = 2)

fit2 <- frfast(DW ~ RC : F, data = barnacle) # with interactions
critical(fit2)
critical(fit2, der = 0)
critical(fit2, der = 1)
critical(fit2, der = 2)
```

---

critical.diff *Differences between the critical points for two factor's levels*

Description

Differences between the estimation of `critical` for two factor's levels.

Usage

```
critical.diff(model, factor1 = NULL, factor2 = NULL, der = NULL)
```

Arguments

`model`	Parametric or nonparametric regression model obtained by `frfast` function.
`factor1`	First factor's level at which to perform the differences between critical points.
`factor2`	Second factor's level at which to perform the differences between critical points.
`der`	Number which determines any inference process. By default `der` is `NULL`. If this term is `0`, the calculate of the differences for the critical point is for the estimate. If it is `1` or `2`, it is designed for the first or second derivative, respectively.

Details

Differences are calculated by subtracting a factor relative to another ($factor2 - factor1$). By default `factor2` and `factor1` are `NULL`, so the differences calculated are for all possible combinations between two factors. Additionally, it is obtained the 95% interval confidence for this difference which let us to make inference about them.

Value

An object is returned with the following elements:

`critical.diff`	a table with a couple of factor's level where it is used to calculate the differences between the critical points, and their 95% interval confidence (for the estimation, first and second derivative).

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Examples

```
library(npregfast)
data(barnacle)
fit2 <- frfast(DW ~ RC : F, data = barnacle, seed = 130853) # with interactions
critical.diff(fit2)
critical.diff(fit2, der = 1)
critical.diff(fit2, der = 1, factor1 = 2, factor2 = 1)
```

---

frfast *Fitting nonparametric models*

Description

This function is used to fit nonparametric models by using local linear kernel smoothers. These models can include or not factor-by-curve interactions. Additionally, a parametric model (allometric model) can be estimated.

Usage

```
frfast(formula, data = data, model = "np", h0 = -1, h = -1, nh = 30,
  weights = NULL, kernel = "epanech", p = 3, kbin = 100, nboot = 500,
  rankl = NULL, ranku = NULL, seed = NULL)
```

Arguments

`formula`	An object of class `formula`: a sympbolic description of the model to be fitted. The details of model specification are given under 'Details'.
`data`	A data frame or matrix containing the model response variable and covariates required by the `formula`.
`model`	Type model used: `model = "np"` nonparametric regression model with local linear kernel smoothers, `model = "allo"` the allometric model.
`h0`	The kernel bandwidth smoothing parameter for the global effect (see refrences for more details at the estimation). Large values of bandwidth make smoother estimates, smaller values of bandwidth make less smooth estimates. The default is a bandwidth compute by cross validation.
`h`	The kernel bandwidth smoothing parameter for the partial effects.

nh	Integer number of equally-spaced bandwidth on which the h is discretised, to speed up computation.
weights	Prior weights on the data.
kernel	Character which determines the smoothing kernel. By default kernel = "epanech", this is, the Epanechnikov density function. Also, several types of kernel funcitons can be used: triangular and Gaussian density function, with "triang" and "gaussian" term, respectively.
p	Degree of polynomial used. Its value must be the value of derivative + 1. The default value is 3 due to the function returns the estimation, first and second derivative.
kbin	Number of binning nodes over which the function is to be estimated.
nboot	Number of bootstrap repeats. Default 500. The wild bootstrap is used when model = "np" and the simple bootstrap when model = "allo".
rankl	Number or vector specifying the minimum value for the interval at which to search the x value which maximizes the estimate, first or second derivative (for each level). The default is the minimum data value.
ranku	Number or vector specifying the maximum value for the interval at which to search the x value which maximizes the estimate, first or second derivative (for each level). The default is the maximum data value.
seed	Seed to be used in the bootstrap procedure.

Details

The models fitted by frfast function are specified in a compact symbolic form. The \~ operator is basic in the formation of such models. An expression of the form y ~ model is interpreted as a specification that the response y is modelled by a predictor specified symbolically by model. The possible terms consist of a variable name or a variable name and a factor name separated by : operator. Such a term is interpreted as the interaction of the continuous variable and the factor.

Value

An object is returned with the following elements:

x	Vector of values of the grid points at which model is to be estimate.
p	Matrix of values of the grid points at which to compute the estimate, their first and second derivative.
pl	Lower values of 95% confidence interval for the estimate, their first and second derivative.
pu	Upper values of 95% confidence interval for the estimate, their first and second derivative.
diff	Differences between the estimation values of a couple of levels (i. e. level 2 - level 1). The same procedure for their first and second derivative.
diffl	Lower values of 95% confidence interval for the differences between the estimation values of a couple of levels. It is performed for their first and second derivative.

diffu	Upper values of 95% confidence interval for the differences between the estimation values of a couple of levels. It is performed for their first and second derivative.
nboot	Number of bootstrap repeats.
n	Total number of data.
dp	Degree of polynomial used.
h0	The kernel bandwidth smoothing parameter for the global effect.
h	The kernel bandwidth smoothing parameter for the partial effects.
fmod	Factor's level for each data.
xdata	Original x values.
ydata	Original y values.
w	Weights on the data.
kbin	Number of binning nodes over which the function is to be estimated.
nf	Number of levels.
max	Value of covariate x which maximizes the estimate, first or second derivative.
maxu	Upper value of 95% confidence interval for the value max.
maxl	Lower value of 95% confidence interval for the value max.
diffmax	Differences between the estimation of max for a couple of levels (i. e. level 2 - level 1). The same procedure for their first and second derivative.
diffmaxu	Upper value of 95% confidence interval for the value diffmax.
diffmaxl	Lower value of 95% confidence interval for the value diffmax.
repboot	Matrix of values of the grid points at which to compute the estimate, their first and second derivative for each bootstrap repeat.
rankl	Maximum value for the interval at which to search the x value which maximizes the estimate, first or second derivative (for each level). The default is the maximum data value.
ranku	Minimum value for the interval at which to search the x value which maximizes the estimate, first or second derivative (for each level). The default is the minimum data value.
nmodel	Type model used: nmodel = 1 the nonparametric model, nmodel = 2 the allometric model.
label	Labels of the variables in the model.
numlabel	Number of labels.
kernel	Character which determines the smoothing kernel.
a	Estimated coefficient in the case of fitting an allometric model.
al	Lower value of 95% confidence interval for the value of a.
au	Upper value of 95% confidence interval for the value of a.
b	Estimated coefficient in the case of fitting an allometric model.
bl	Lower value of 95% confidence interval for the value of b.

bu	Upper value of 95% confidence interval for the value of b.
name	Name of the variables in the model.
formula	A sympbolic description of the model to be fitted.
nh	Integer number of equally-spaced bandwidth on which the h is discretised.
r2	Coefficient of determination (in the case of the allometric model).

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Examples

```
library(npregfast)
data(barnacle)

# Nonparametric regression without interactions
fit <- frfast(DW ~ RC, data = barnacle)
fit
summary(fit)

# Change the number of binning nodes and bootstrap replicates
fit <- frfast(DW ~ RC, data = barnacle, kbin = 200, nboot = 100)

# Nonparametric regression with interactions
fit2 <- frfast(DW ~ RC : F, data = barnacle)
fit2
summary(fit2)


# Allometric model
fit3 <- frfast(DW ~ RC, data = barnacle, model = "allo")
summary(fit3)

fit4 <- frfast(DW ~ RC : F, data = barnacle, model = "allo")
summary(fit4)
```

---

globaltest *Testing the equality of the* M *curves specific to each level*

Description

This function can be used to test the equality of the M curves specific to each level.

Usage

```
globaltest(formula, data = data, der, weights = NULL, nboot = 500,
  h0 = -1, h = -1, nh = 30, kernel = "epanech", p = 3, kbin = 100,
  seed = NULL)
```

Arguments

formula	An object of class formula: a sympbolic description of the model to be fitted.
data	A data frame or matrix containing the model response variable and covariates required by the formula.
der	Number which determines any inference process. By default der is NULL. If this term is 0, the testing procedures is applied for the estimate. If it is 1 or 2, it is designed for the first or second derivative, respectively.
weights	Prior weights on the data.
nboot	Number of bootstrap repeats.
h0	The kernel bandwidth smoothing parameter for the global effect. Large values of bandwidth make smoother estimates, smaller values of bandwidth make less smooth estimates. The default is a bandwidth compute by cross validation.
h	The kernel bandwidth smoothing parameter for the partial effects.
nh	Integer number of equally-spaced bandwidth on which the h is discretised, to speed up computation.
kernel	Character which determines the smoothing kernel. By default kernel = "epanech", this is, the Epanechnikov density function. Also, several types of kernel funcitons can be used: triangular and Gaussian density function, with "triang" and "gaussian" term, respectively.
p	Degree of polynomial used. Its value must be the value of derivative + 1. The default value is 3 due to the function returns the estimation, first and second derivative.
kbin	Number of binning nodes over which the function is to be estimated.
seed	Seed to be used in the bootstrap procedure.

Details

globaltest can be used to test the equality of the M curves specific to each level. This bootstrap based test assumes the following null hypothesis:

$$H_0^r : m_1^r(\cdot) = \ldots = m_M^r(\cdot)$$

versus the general alternative

$$H_1^r : m_i^r(\cdot) \neq m_j^r(\cdot) \quad \text{for} \quad \text{some} \quad i,j \in \{1,\ldots,\mathrm{M}\}.$$

Note that, if H_0 is not rejected, then the equality of critical points will also accepted.

To test the null hypothesis, it is used an statistic, T, based on direct nonparametric estimates of the curves.

If the null hypothesis is true, the T value should be close to zero but is generally greater. The test rule based on T consists of rejecting the null hypothesis if $T > T^{1-\alpha}$, where T^p is the empirical p-percentile of T under the null hypothesis. To obtain this percentile, we have used bootstrap techniques. See details in references.

Value

The T value and the p-value are returned. Additionally, it is shown the decision, accepted or rejected, of the global test. The null hypothesis is rejected if the p-value< 0.05.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Examples

```
library(npregfast)
data(barnacle)
globaltest(DW ~ RC : F, data = barnacle, der = 1, seed = 130853)
```

---

localtest *Testing the equality of critical points*

Description

This function can be used to test the equality of the M critical points estimated from the respective level-specific curves.

Usage

```
localtest(formula, data = data, der, weights = NULL, nboot = 500,
  h0 = -1, h = -1, nh = 30, kernel = "epanech", p = 3, kbin = 100,
  rankl = NULL, ranku = NULL, seed = NULL)
```

Arguments

formula	An object of class formula: a sympbolic description of the model to be fitted.
data	A data frame or matrix containing the model response variable and covariates required by the formula.
der	Number which determines any inference process. By default der is NULL. If this term is 0, the testing procedures is applied for the estimate. If it is 1 or 2, it is designed for the first or second derivative, respectively.
weights	Prior weights on the data.
nboot	Number of bootstrap repeats.
h0	The kernel bandwidth smoothing parameter for the global effect. Large values of bandwidth make smoother estimates, smaller values of bandwidth make less smooth estimates. The default is a bandwidth compute by cross validation.
h	The kernel bandwidth smoothing parameter for the partial effects.
nh	Integer number of equally-spaced bandwidth on which the h is discretised, to speed up computation.
kernel	Character which determines the smoothing kernel. By default kernel = "epanech", this is, the Epanechnikov density function. Also, several types of kernel funcitons can be used: triangular and Gaussian density function, with "triang" and "gaussian" term, respectively.
p	Degree of polynomial used. Its value must be the value of derivative + 1. The default value is 3 due to the function returns the estimation, first and second derivative.
kbin	Number of binning nodes over which the function is to be estimated.
rankl	Number or vector specifying the minimum value for the interval at which to search the x value which maximizes the estimate, first or second derivative (for each level). The default is the minimum data value.
ranku	Number or vector specifying the maximum value for the interval at which to search the x value which maximizes the estimate, first or second derivative (for each level). The default is the maximum data value.
seed	Seed to be used in the bootstrap procedure.

Details

localtest can be used to test the equality of the M critical points estimated from the respective level-specific curves. Note that, even if the curves and/or their derivatives are different, it is possible for these points to be equal.

For instance, taking the maxima of the first derivatives into account, interest lies in testing the following null hypothesis

$$H_0 : x_{01} = \ldots = x_{0M}$$

versus the general alternative

$$H_1 : x_{0i} \neq x_{0j} \quad \text{for} \quad \text{some} \quad i,j \in \{1, \ldots, M\}.$$

The above hypothesis is true if $d = x_{0j} - x_{0k} = 0$ where

$$(j,k) = argmax \quad (l,m) \quad \{1 \leq l < m \leq M\} \quad |x_{0l} - x_{0m}|,$$

otherwise H_0 is false. It is important to highlight that, in practice, the true x_{0j} are not known, and consequently neither is d, so an estimate $\hat{d} = \hat{x}_{0j} - \hat{x}_{0k}$ is used, where, in general, $\hat{x}_{0l}$ are the estimates of x_{0l} based on the estimated curves $\hat{m}_l$ with $l = 1, \ldots, M$.

Needless to say, since $\hat{d}$ is only an estimate of the true d, the sampling uncertainty of these estimates needs to be acknowledged. Hence, a confidence interval (a, b) is created for d for a specific level of confidence (95%). Based on this, the null hypothesis is rejected if zero is not contained in the interval.

Note that if this hypothesis is rejected (and the factor has more than two levels), one option could be to use the `maxp.diff` function in order to obtain the differences between each pair of factor's levels.

Value

The estimate of d value is returned and its confidence interval for a specific-level of confidence, i.e. 95%. Additionally, it is shown the decision, accepted or rejected, of the local test. Based on the null hypothesis is rejected if a zero value is not within the interval.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Examples

```
library(npregfast)
data(barnacle)
localtest(DW ~ RC : F, data = barnacle, der = 1, seed = 130853)
```

`npregfast` `npregfast`*: Nonparametric Estimation of Regression Models with Factor-By-Curve Interactions.*

Description

This package provides a method for obtain nonparametric estimates of regression models using local linear kernel smoothers. Particular features of the package are facilities for fast smoothness estimation, and the calculation of their first and second derivative. Users can define the smoothers parameters. Confidences intervals calculation is provided by bootstrap methods. Binning techniques were applied to speed up computation in the estimation and testing processes.

Details

Package:	npregfast
Type:	Package
Version:	1.0
Date:	2015-06-29
License:	MIT + file LICENSE

CAMBIAR `npregfast` provides functions for nonparametric regression models `frfast`, `plot.frfast`. The term `frfast` is taken to include any nonparametric regression estimated by local lineal kernel smoothers. A number of other functions such `summary.frfast` are also provided, for extracting information from a fitted `frfast` object.

For a listing of all routines in the NPRegfast package type: `library(help="npregfast")`.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Efron, B. (1979). Bootstrap methods: another look at the jackknife. Annals of Statistics, 7, 1–26.

Efron, E. and Tibshirani, R. J. (1993). An introduction to the Bootstrap. Chapman and Hall, London.

Huxley, J. S. (1924). Constant differential growth-ratios and their significance. Nature, 114:895–896.

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Sestelo, M. and Roca-Pardinas, J. (2011). A new approach to estimation of length-weight relationship of *Pollicipes pollicipes* (Gmelin, 1789) on the Atlantic coast of Galicia (Northwest Spain): some aspects of its biology and management. Journal of Shellfish Research, 30(3), 939–948.

Wand, M. P. and Jones, M. C. (1995). Kernel Smoothing. Chapman & Hall, London.

`plot.frfast` *Visualization of* `frfast` *objects*

Description

Useful for drawing the estimated regression function, first and second derivative (for each factor's level).

Usage

```
## S3 method for class 'frfast'
plot(x = model, y, fac = NULL, der = NULL,
  points = TRUE, xlab = model$name[2], ylab = model$name[1],
  ylim = NULL, main = NULL, col = "black", CIcol = "black",
  ablinecol = "red", abline = TRUE, type = "l", CItype = "l", lwd = 2,
  CIlwd = 1, lty = 1, CIlty = 2, ...)
```

Arguments

x	frfast object.
y	NULL.
fac	Vector which determines the level to take into account in the plot. By default is NULL.
der	Number or vector which determines any inference process. By default der is NULL. If this term is 0, the plot shows the initial estimate. If it is 1 or 2, it is designed for the first or second derivative, respectively.
points	Draw the original data into the plot. By default it is TRUE.
xlab	A title for the x axis.
ylab	A title for the y axis.
ylim	The y limits of the plot.
main	An overall title for the plot.
col	A specification for the default plotting color.
CIcol	A specification for the default confidence intervals plotting color.
ablinecol	The color to be used for abline.
abline	Draw an horizontal line into the plot of the second derivative of the model.
type	What type of plot should be drawn. Possible types are, p for points, l for lines, o for overplotted, etc. See details in par.
CItype	What type of plot should be drawn for confidence intervals. Possible types are, p for points, l for lines, o for overplotted.
lwd	The line width, a positive number, defaulting to 1. See details in par.
CIlwd	The line width for confidence intervals, a positive number, defaulting to 1.
lty	The line type. Line types can either be specified as an integer (0 = blank, 1 = solid (default), 2 = dashed, 3 = dotted, 4 = dotdash, 5 = longdash, 6 = twodash). See details in par.
CIlty	The line type for confidence intervals. Line types can either be specified as an integer (0 = blank, 1 = solid (default), 2 = dashed, 3 = dotted, 4 = dotdash, 5 = longdash, 6 = twodash).
...	Other options.

Value

Simply produce a plot.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

Examples

```
library(npregfast)
data(barnacle)

# Nonparametric regression without interactions
fit <- frfast(DW ~ RC, data = barnacle)
plot(fit)
plot(fit, der = 0)
plot(fit, der = 0, points = FALSE)
plot(fit, der = 1, col = "red", CIcol = "blue")

# Nonparametric regression with interactions
fit2 <- frfast(DW ~ RC : F, data = barnacle)
plot(fit2)
plot(fit2, der = 0, fac = 2)
plot(fit2, der = 1, col = "grey", CIcol = "red")
plot(fit2, der = c(0,1), fac = c(1,2))
```

---

plotdiff *Visualization of the differences between the estimated curves for two factor's levels*

Description

Useful for drawing the differences between the estimation of curves (initial estimate, first or second derivative) for two factor's levels. Missing values of factor's levels is not allowed.

Usage

```
plotdiff(model, factor2, factor1, der = NULL, est.include = FALSE,
  xlab = model$name[2], ylab = model$name[1], ylim = NULL, main = NULL,
  col = "black", CIcol = "grey50", ablinecol = "red", abline = TRUE,
  type = "l", CItype = "l", lwd = 1, CIlwd = 1.5, lty = 1,
  CIlty = 2, ...)
```

Arguments

model	Parametric or nonparametric regression out obtained by frfast function.
factor2	Second factor's level at which to perform the differences between curves.
factor1	First factor's level at which to perform the differences between curves.
der	Number or vector which determines any inference process. By default der is NULL. If this term is 0, the plot shows the differences between estimated regression functions. If it is 1 or 2, it is designed for the first or second derivative, respectively.

est.include	Draws the estimates of the model. By default it is FALSE.
xlab	A title for the x axis.
ylab	A title for the y axis.
ylim	The y limits of the plot.
main	An overall title for the plot.
col	A specification for the default plotting color.
CIcol	A specification for the default confidence intervals plotting color.
ablinecol	The color to be used for abline.
abline	Draw an horizontal line into the plot of the second derivative of the model.
type	What type of plot should be drawn. Possible types are, p for points, l for lines, o for overplotted, etc. See details in par.
CItype	What type of plot should be drawn for confidence intervals. Possible types are, p for points, l for lines, o for overplotted.
lwd	The line width, a positive number, defaulting to 1. See details in par.
CIlwd	The line width for confidence intervals, a positive number, defaulting to 1.
lty	The line type. Line types can either be specified as an integer (0 = blank, 1 = solid (default), 2 = dashed, 3 = dotted, 4 = dotdash, 5 = longdash, 6 = twodash). See details in par.
CIlty	The line type for confidence intervals. Line types can either be specified as an integer (0 = blank, 1 = solid (default), 2 = dashed, 3 = dotted, 4 = dotdash, 5 = longdash, 6 = twodash).
...	Other options.

Value

Simply produce a plot.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

Examples

```
library(npregfast)
data(barnacle)

# Nonparametric regression with interactions
fit2 <- frfast(DW ~ RC : F, data = barnacle)
plotdiff(fit2, factor2 = 1, factor1 = 2)
plotdiff(fit2, factor2 = 2, factor1 = 1, der = 1, col = "blue", CIcol = "grey")
plotdiff(fit2, 1, 2, der = c(0, 1), ylim = c(-0.05, 0.05))
```

predict.frfast *Prediction from fitted* frfast *model*

Description

Takes a fitted frfast object and produces predictions (with their 95% confidence intervals) from a fitted model with interactions or without interactions.

Usage

```
## S3 method for class 'frfast'
predict(object = model, newdata, fac = NULL, der = NULL,
  seed = NULL, ...)
```

Arguments

object	A fitted frfast object as produced by frfast().
newdata	A data frame containing the values of the model covariates at which predictions are required. If newdata is provided, then it should contain all the variables needed for prediction: a warning is generated if not.
fac	Factor's level to take into account. By default is NULL.
der	Number which determines any inference process. By default der is NULL. If this term is 0, the function returns the initial estimate. If it is 1 or 2, it is designed for the first or second derivative, respectively.
seed	Seed to be used in the bootstrap procedure.
...	Seed to be used in the bootstrap procedure.

Value

predict.frfast computes and returns a list containing predictions of the estimates, first and second derivative, with their 95% confidence intervals.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

Examples

```
library(npregfast)
data(barnacle)

# Nonparametric regression without interactions
fit <- frfast(DW ~ RC, data = barnacle)
nd <- data.frame(RC = c(10, 14, 18))
predict(fit, newdata = nd)

# Nonparametric regression with interactions
```

```
fit2 <- frfast(DW ~ RC : F, data = barnacle)
nd2 <- data.frame(RC = c(10, 15, 20))
predict(fit2, newdata = nd2)
predict(fit2, newdata = nd2, der = 0, fac = 2)
```

`summary.frfast` *Summarizing fits of* `frfast` *class*

Description

Takes a fitted `frfast` object produced by `frfast()` and produces various useful summaries from it.

Usage

```
## S3 method for class 'frfast'
summary(object = model, ...)
```

Arguments

`object`	a fitted `frfast` object as produced by `frfast()`.
`...`	additional arguments affecting the predictions produced.

Details

`print.frfast` tries to be smart about `summary.frfast`.

Value

`summary.frfast` computes and returns a list of summary information for a fitted `frfast` object.

`model`	type of model: nonparametric or allometric.
`h`	the kernel bandwidth smoothing parameter.
`dp`	degree of the polynomial.
`nboot`	number of bootstrap repeats.
`kbin`	number of binning nodes over which the function is to be estimated.
`n`	total number of data.
`fmod`	factor's levels.
`coef`	if `model = "allo"`, coefficients of the model.

Author(s)

Marta Sestelo, Nora M. Villanueva and Javier Roca-Pardinas.

References

Sestelo, M. (2013). Development and computational implementation of estimation and inference methods in flexible regression models. Applications in Biology, Engineering and Environment. PhD Thesis, Department of Statistics and O.R. University of Vigo.

Examples

```
library(npregfast)
data(barnacle)

# Nonparametric regression without interactions
fit <- frfast(DW ~ RC, data = barnacle)
fit
summary(fit)

# Nonparametric regression with interactions
fit2 <- frfast(DW ~ RC : F, data = barnacle)
fit2
summary(fit2)

# Allometric model
fit3 <- frfast(DW ~ RC, data = barnacle, model = "allo")
fit3
summary(fit3)
```

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