

Package ‘gamlss’

October 14, 2009

Description The library for fitting GAMLSS models.

Title Generalized Additive Models for Location Scale and Shape.

LazyLoad yes

Version 3.0-1

Date 2009-10-14

Depends R (>= 2.4.0), graphics, stats, splines, utils, gamlss.dist, gamlss.data

Imports MASS, survival

Author Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby
<r.rigby@londonmet.ac.uk> with contributions from Calliope Akantziliotou.

Maintainer Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>

License GPL-2 | GPL-3

URL <http://www.gamlss.com/>

Repository CRAN

Date/Publication 2009-10-14 13:12:56

R topics documented:

gamlss-package	3
additive.fit	4
bfp	5
centiles	7
centiles.com	10
centiles.pred	11
centiles.split	13
coef.gamlss	15
cs	16
deviance.gamlss	19

find.hyper	20
fitted.gamlss	22
fitted.plot	24
formula.gamlss	25
gamlss	26
gamlss.control	30
gamlss.cs	32
gamlss.fp	33
gamlss.lo	34
gamlss.ps	36
gamlss.ra	37
gamlss.random	38
gamlss.rc	39
gamlss.scope	40
glim.control	42
histDist	43
IC	45
lo	46
lpred	48
model.frame.gamlss	49
par.plot	51
pdf.plot	52
plot.gamlss	54
polyS	56
predict.gamlss	57
print.gamlss	59
prof.dev	60
prof.term	62
ps	63
Q.stats	66
ra	67
random	69
rc	70
refit	71
residuals.gamlss	73
ridge	74
rqres.plot	76
stepGAIC	77
summary.gamlss	80
term.plot	82
update.gamlss	84
VGD	85
wp	87

Description

This a collection of functions to fit Generalized Additive Models for Location Scale and Shape(GAMLSS) and handled gamlss objects.

GAMLSS were introduced by Rigby and Stasinopoulos (2005). GAMLSS is a general framework for univariate regression type statistical problems using new ways of dealing with overdispersion, skewness and kurtosis in the response variable. In GAMLSS the exponential family distribution assumption used in Generalized Linear Model (GLM) and Generalized Additive Model (GAM),(see Nelder and Wedderburn, 1972 and Hastie and Tibshirani, 1990, respectively) is relaxed and replaced by a very general distribution family including highly skew and kurtotic discrete and continuous distributions. The systematic part of the model is expanded to allow modelling not only the mean (or location) but other parameters of the distribution of the response variable as linear parametric, nonlinear parametric or additive non-parametric functions of explanatory variables and/or random effects terms. Maximum (penalized) likelihood estimation is used to fit the models.

Details

Package: gamlss
Type: Package
Version: 1.5-0
Date: 2006-12-13
License: GPL (version 2 or later) See file LICENSE

This package allow the user to model the distribution of the response variable using a variety of one, two, three and four parameter families of distributions. The distributions implemented currently can be found in `gamlss.family`. Other distributions can be easily added. In the current implementation of GAMLSS several additive terms have been implemented including regression splines, smoothing splines, penalized splines, varying coefficients, fractional polynomials and random effects. Other additive terms can be easily added.

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk> with contributions from Calliope Akantziliotou.

Maintainer: Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>

References

Nelder, J. A. and Wedderburn, R. W. M. (1972). Generalized linear models. *J. R. Statist. Soc. A.*, **135** 370-384.

Hastie, T. J. and Tibshirani, R. J. (1990). *Generalized Additive Models*. Chapman and Hall, London.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

Examples

```
data(abdom)
mod<-gamlss(y~cs(x,df=3),sigma.fo=~cs(x,df=1),family=BCT, data=abdom, method=mixed(1,20))
plot(mod)
rm(mod)
```

additive.fit *Implementing Backfitting in GAMLSS*

Description

This function is not to be used on its own. It is used for backfitting in the GAMLSS fitting algorithms and it is based on the equivalent function written by Trevor Hastie in the gam() S-plus implementation, (Chambers and Hastie, 1991).

Usage

```
additive.fit(x, y, w, s, who, smooth.frame, maxit = 30, tol = 0.001,
            trace = FALSE, se = TRUE, ...)
```

Arguments

x	the linear part of the explanatory variables
y	the response variable
w	the weights
s	the matrix containing the smoothers
who	the current smoothers
smooth.frame	the data frame used for the smoothers
maxit	maximum number of iterations in the backfitting
tol	the tolerance level for the backfitting
trace	whether to trace the backfitting algorithm
se	whether standard errors are required
...	for extra arguments

Details

This function should not be used on its own

Value

Returns a list with the linear fit plus the smothers

Author(s)

Mikis Stasinopoulos

References

Chambers, J. M. and Hastie, T. J. (1991). *Statistical Models in S*, Chapman and Hall, London.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

bfp

Functions to fit fractional polynomials in GAMLSS

Description

The function `bfp` generate a power polynomial basis matrix which (for given powers) can be used to fit power polynomials in one x-variable. The function `fp` takes a vector and returns it with several attributes. The vector is used in the construction of the model matrix. The function `fp()` is not used for fitting the fractional polynomial curves but assigns the attributes to the vector to aid `gamlss` in the fitting process. The function doing the fitting is `gamlss.fp()` which is used at the backfitting function `additive.fit` (but never used on its own). The (experimental) function `pp` can be use to fit power polynomials as in $a + b_1x^{p_1} + b_2x^{p_2}$., where `p1` and `p2` have arbitrary values rather restricted as in the `fp` function.

Usage

```
bfp(x, powers = c(1, 2), shift = NULL, scale = NULL)
fp(x, npoly = 2, shift = NULL, scale = NULL)
pp(x, start = list(), shift = NULL, scale = NULL)
```

Arguments

<code>x</code>	the explanatory variable to be used in functions <code>bfp()</code> or <code>fp()</code> . Note that this is different from the argument <code>x</code> use in <code>gamlss.fp</code> (a function used in the backfitting but not by straight by the user)
<code>powers</code>	a vector containing as elements the powers in which the <code>x</code> has to be raised
<code>shift</code>	a number for shifting the <code>x</code> -variable. The default values is zero, if <code>x</code> is positive, or the minimum of the positive difference in <code>x</code> minus the minimum of <code>x</code>
<code>scale</code>	a positive number for scalling the <code>x</code> -variable. The default values is $10^{(\text{sign}(\log_{10}(\text{range}))) * \text{trunc}(\text{abs}(\log_{10}(\text{range})))}$
<code>npoly</code>	a positive indicating how many fractional polynomials should be considered in the fit. Can take the values 1, 2 or 3 with 2 as default
<code>start</code>	a list containing the starting values for the non-linear maximization to find the powers. The results from fitting the equivalent fractional polynomials can be used here

Details

The above functions are an implementation of the fractional polynomials introduced by Royston and Altman (1994). The three functions involved in the fitting are loosely based on the fractional polynomials implementation in S-plus written by Gareth Amber. The function `bfp` generates the right design matrix for the fitting a power polynomial of the type $a + b_1x^{p_1} + b_2x^{p_2} + \dots + b_kx_k^{p_k}$. For given powers p_1, p_2, \dots, p_k given as the argument `powers` in `bfp()` the function can be used to fit power polynomials in the same way as the functions `poly()` or `bs()` (of package `splines`) are used to fit orthogonal or piecewise polynomials respectively. The function `fp()`, which is working as a smoother in `gamlss`, is used to fit the best fractional polynomials within a set of power values. Its argument `npoly` determines whether one, two or three fractional polynomials should be used in the fitting. For a fixed number `npoly` the algorithm looks for the best fitting fractional polynomials in the list `c(-2, -1, -0.5, 0, 0.5, 1, 2, 3)`. Note that `npoly=3` is rather slow since it fits all possible combinations 3-way combinations at each backfitting interaction. The function `gamlss.fp()` is an internal function of `GAMLSS` allowing the fractional polynomials to be fitted in the backfitting cycle of `gamlss`, and should be not used on its own.

Value

The function `bfp` returns a matrix to be used as part of the design matrix in the fitting.

The function `fp` returns a vector with values zero to be included in the design matrix but with attributes useful in the fitting of the fractional polynomials algorithm in `gamlss.fp`.

Warning

Since the model constant is included in both the design matrix `X` and in the backfitting part of fractional polynomials, its values is wrongly given in the `summary`. Its true values is the model constant minus the constant from the fractional polynomial fitting ??? What happens if more that one fractional polynomials are fitted?

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (b.rigby@londonmet.ac.uk)

References

- Amber G. (1999) Fracial polynomials in S-plus, <http://lib.stat.cmu.edu/S/fracpoly>.
- Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.
- Royston, P. and Altman, D. G., (1994). Regression using fractional polynomials of continuous covariates: parsimonious parametric modelling (with discussion), *Appl. Statist.*, **43**, 429-467.
- Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).
- Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [gamlss.family](#)

Examples

```
data(abdom)
#fits polynomials with power 1 and .5
mod1<-gamlss(y~bfp(x,c(1,0.5)),data=abdom)
# fit the best of one fractional polynomial
m1<-gamlss(y~fp(x,1),data=abdom)
# fit the best of two fractional polynomials
m2<-gamlss(y~fp(x,2),data=abdom)
# fit the best of three fractional polynomials
m3<-gamlss(y~fp(x,3),data=abdom)
# get the coefficient for the second model
m2$mu.coef$mo
# now power polynomials using the best 2 fp c()
m4 <- gamlss(y ~ pp(x, c(1,3)), data = abdom)
# This is not good idea in this case because
# if you look at the fitted values you see what it went wrong
plot(y~x,data=abdom)
lines(fitted(m2,"mu")~abdom$x,col="red")
lines(fitted(m4,"mu")~abdom$x,col="blue")
```

centiles

Plots the centile curves for a GAMLSS object

Description

This function plots centiles curves for distributions belonging to the GAMLSS family of distributions. The function also tabulates the sample percentages below each centile curve (for comparison with the model percentages given by the argument *cent*.) A restriction of the function is that it applies to models with one explanatory variable only.

Usage

```
centiles(obj, xvar = NULL, cent = c(0.4, 2, 10, 25, 50, 75, 90, 98, 99.6),
         legend = TRUE, ylab = "y", xlab = "x", main = NULL,
         main.gsub = "@", xleg = min(xvar), yleg = max(obj$y),
         xlim = range(xvar), ylim = range(obj$y), save = FALSE,
         plot = TRUE, pch = "+", col = "blue",
         col.centiles = 1:length(cent) + 2, lty.centiles = 1, lwd.centiles = 1, ...)
```

Arguments

<code>obj</code>	a fitted <code>gamlss</code> object from fitting a <code>gamlss</code> distribution
<code>xvar</code>	the unique explanatory variable
<code>cent</code>	a vector with elements the % centile values for which the centile curves have to be evaluated
<code>legend</code>	whether a legend is required in the plot or not, the default is <code>legend=TRUE</code>
<code>ylab</code>	the y-variable label
<code>xlab</code>	the x-variable label
<code>main</code>	the main title here as character. If <code>NULL</code> the default title "centile curves using NO" (or the relevant distributions name) is shown
<code>main.gsub</code>	if the <code>main.gsub</code> (with default "@") appears in the main title then it is substituted with the default title.
<code>xleg</code>	position of the legend in the x-axis
<code>yleg</code>	position of the legend in the y-axis
<code>xlim</code>	the limits of the x-axis
<code>ylim</code>	the limits of the y-axis
<code>save</code>	whether to save the sample percentages or not with default equal to <code>FALSE</code> . In this case the sample percentages are printed but are not saved
<code>plot</code>	whether to plot the centiles. This option is useful for <code>centile.split</code>
<code>pch</code>	the character to be used as the default in plotting points see <code>par</code>
<code>col</code>	plotting colour see <code>par</code>
<code>col.centiles</code>	Plotting colours for the centile curves
<code>lty.centiles</code>	line type for the centile curves
<code>lwd.centiles</code>	The line width for the centile curves
<code>...</code>	for extra arguments

Details

Centiles are calculated using the fitted values in `obj` and `xvar` must correspond exactly to the predictor in `obj` to plot correctly.

`col.centiles`, `lty.centiles` and `lwd.centiles` may be vector arguments and are recycled to the length `cent` if necessary.

Value

A centile plot is produced and the sample centiles below each centile curve are printed (or saved)

Warning

This function is appropriate only when one continuous explanatory variable is fitted in the model

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk)
with contribution from Steve Ellison

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [centiles.split](#), [centiles.com](#)

Examples

```
data(abdom)
h<-gamlss(y~cs(x,df=3), sigma.formula=~cs(x,1), family=BCT, data=abdom)
# default plot
centiles(h,xvar=abdom$x)
# control of colours and lines
centiles(h, xvar=abdom$x, col.cent=c(2,3,4,5,1,5,4,3,2,1),
         lwd.cent=c(1,1,1,1,2,1,1,1,1))
#Control line types
centiles(h, xvar=abdom$x, col.cent=1, cent=c(.5,2.5,50,97.5,99.5),
         lty.centiles=c(3,2,1,2,3),lwd.cent=c(1,1,2,1,1))
# control of the main title
centiles(h, xvar=abdom$x, main="Abdominal data \n @")
rm(h)
```

Description

This function compares centiles curves for more than one GAMLSS objects. It is based on the `centiles` function. The function also tabulates the sample percentages below each centile curve (for comparison with the model percentages given by the argument `cent`.) A restriction of the function is that it applies to models with one explanatory variable only.

Usage

```
centiles.com(obj, ..., xvar = NULL, cent = c(0.4, 10, 50, 90, 99.6),
             legend = TRUE, ylab = "y", xlab = "x", xleg = min(xvar),
             yleg = max(obj$y), xlim = range(xvar), ylim = NULL,
             no.data = FALSE, color = TRUE, plot = TRUE)
```

Arguments

<code>obj</code>	a fitted <code>gamlss</code> object from fitting a <code>gamlss</code> continuous distribution
<code>...</code>	optionally more fitted GAMLSS model objects
<code>xvar</code>	the unique explanatory variable
<code>cent</code>	a vector with elements the % centile values for which the centile curves have to be evaluated
<code>legend</code>	whether a legend is required in the plot or not, the default is <code>legend=TRUE</code>
<code>ylab</code>	the y-variable label
<code>xlab</code>	the x-variable label
<code>xleg</code>	position of the legend in the x-axis
<code>yleg</code>	position of the legend in the y-axis
<code>xlim</code>	the limits of the x-axis
<code>ylim</code>	the limits of the y-axis
<code>no.data</code>	whether the data should plotted, default <code>no.data=FALSE</code> or not <code>no.data=TRUE</code>
<code>color</code>	whether the fitted centiles are shown in colour, <code>color=TRUE</code> (the default) or not <code>color=FALSE</code>
<code>plot</code>	whether to plot the centiles

Value

Centile plots are produced for the different fitted models and the sample centiles below each centile curve are printed

Warning

This function is appropriate only when one continuous explanatory variable is fitted in the model

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk> and Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

See Also

[gamlss](#), [centiles](#), [centiles.split](#)

Examples

```
data(abdom)
h1<-gamlss(y~cs(x,df=3), sigma.formula=~cs(x,1), family=BCT, data=abdom)
h2<-gamlss(y~lo(x,span=0.4), sigma.formula=~lo(x,span=0.4), family=BCT, data=abdom )
centiles.com(h1,h2,xvar=abdom$x)
rm(h1,h2)
```

centiles.pred

Creating predictive centiles values

Description

This function creates predictive centiles curves for new x-values given a GAMLSS fitted model. The function has three options: i) for given new x-values and given percentage centiles calculates a matrix containing the centiles values for y, ii) for given new x-values and standard normalized centile values calculates a matrix containing the centiles values for y, iii) for given new x-values and new y-values calculates the z-scores. A restriction of the function is that it applies to models with only one explanatory variable.

Usage

```
centiles.pred(obj, type = c("centiles", "z-scores", "standard-centiles"),
             xname = NULL, xvalues = NULL, power = NULL, yval = NULL,
             cent = c(0.4, 2, 10, 25, 50, 75, 90, 98, 99.6),
             dev = c(-4, -3, -2, -1, 0, 1, 2, 3, 4),
             plot = FALSE, legend = TRUE,
             ...)
```

Arguments

obj	a fitted gamlss object from fitting a gamlss continuous distribution
type	the default, "centiles", gets the centiles values given in the option cent. type="standard-centiles" gets the standard centiles given in the dev. type="z-scores" gets the z-scores for given y and x new values
xname	the name of the unique explanatory variable (it has to be the same as in the original fitted model)
xvalues	the new values for the explanatory variable where the prediction will take place
power	if power transformation is needed (but read the note below)
yval	the response values for a given x required for the calculation of "z-scores"
cent	a vector with elements the % centile values for which the centile curves have to be evaluated
dev	a vector with elements the standard normalized values for which the centile curves have to be evaluated in the option type="standard-centiles"
plot	whether to plot the "centiles" or the "standard-centiles", the default is plot=FALSE
legend	whether a legend is required in the plot or not, the default is legend=TRUE
...	for extra arguments

Value

a vector (for option type="z-scores") or a matrix for options type="centiles" or type="standard-centiles" containing the appropriate values

Warning

See example below of how to use the function when power transformation is used for the x-variables

Note

The power option should be only used if the model

Author(s)

Mikis Stasinopoulos , (d.stasinopoulos@londonmet.ac.uk), based on ideas of Elaine Borghie from the World Health Organization

References

- Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.
- Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).
- Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [centiles](#), [centiles.split](#)

Examples

```
# bring the data and fit the model
data(abdom)
a<-gamlss(y~cs(x),sigma.fo=~cs(x), data=abdom, family=BCT)
#plot the centiles
centiles(a,xvar=abdom$x)
# calculate the centiles at new x values
newx<-seq(12,40,2)
mat <- centiles.pred(a, xname="x", xvalues=newx )
mat
# now plot the centiles
  mat <- centiles.pred(a, xname="x",xvalues=newx, plot=TRUE )
# calculate standard-centiles for new x values using the fitted model
newx <- seq(12,40,2)
  mat <- centiles.pred(a, xname="x",xvalues=newx, type="standard-centiles" )
  mat
# now plot the centiles
mat <- centiles.pred(a, xname="x",xvalues=newx, type="s", plot = TRUE )
# create new y and x values and plot them in the previous plot
newx <- c(20,21.2,23,20.9,24.2,24.1,25)
newy <- c(130,121,123,125,140,145,150)
for(i in 1:7) points(newx[i],newy[i],col="blue")
# now calculate their z-scores
znewx <- centiles.pred(a, xname="x",xvalues=newx,yval=newy, type="z-scores" )
znewx
# now with transformed x-variable within the formula
aa<-gamlss(y~cs(x^0.5),sigma.fo=~cs(x^0.5), data=abdom, family=BCT)
centiles(aa,xvar=abdom$x)
mat <- centiles.pred(aa, xname="x",xvalues=c(30) )
xx<-rep(mat[,1],9)
yy<-mat[,2:10]
points(xx,yy,col="red")
# now with x-variable previously transformed
nx<-abdom$x^0.5
aa<-gamlss(y~cs(nx),sigma.fo=~cs(nx), data=abdom, family=BCT)
centiles(aa, xvar=abdom$x)
newd<-data.frame( abdom, nx=abdom$x^0.5)
mat <- centiles.pred(aa, xname="nx", xvalues=c(30), power=0.5, data=newd)
xxx<-rep(mat[,1],9)
yyy<-mat[,2:10]
points(xxx,yyy,col="red")
```

Description

This function plots centiles curves for separate ranges of the unique explanatory variable *x*. It is similar to the `centiles` function but the range of *x* is split at a user defined values `xcut.point` into *r* separate ranges. The functions also tabulates the sample percentages below each centile curve for each of the *r* ranges of *x* (for comparison with the model percentage given by `cent`) The model should have only one explanatory variable.

Usage

```
centiles.split(obj, xvar = NULL, xcut.points = NULL, n.inter = 4,
              cent = c(0.4, 2, 10, 25, 50, 75, 90, 98, 99.6),
              legend = FALSE, main = NULL, main.gsub = "@",
              ylab = "y", xlab = "x", ylim = NULL, overlap = 0,
              save = TRUE, plot = TRUE, ...)
```

Arguments

<code>obj</code>	a fitted <code>gamlss</code> object from fitting a <code>gamlss</code> continuous distribution
<code>xvar</code>	the unique explanatory variable
<code>xcut.points</code>	the x-axis cut off points e.g. <code>c(20,30)</code> . If <code>xcut.points=NULL</code> then the <code>n.inter</code> argument is activated
<code>n.inter</code>	if <code>xcut.points=NULL</code> this argument gives the number of intervals in which the x-variable will be splited, with default 4
<code>cent</code>	a vector with elements the % centile values for which the centile curves are to be evaluated
<code>legend</code>	whether a legend is required in the plots or not, the default is <code>legend=FALSE</code>
<code>main</code>	the main title as character. If <code>NULL</code> the default title (shown the intervals) is shown
<code>main.gsub</code>	if the <code>main.gsub</code> (with default "@") appears in the <code>main</code> title then it is substituted with the default title.
<code>ylab</code>	the y-variable label
<code>xlab</code>	the x-variable label
<code>ylim</code>	the range of the y-variable axis
<code>overlap</code>	how much overlapping in the <code>xvar</code> intervals. Default value is <code>overlap=0</code> for non overlapping intervals
<code>save</code>	whether to save the sample percentages or not with default equal to <code>TRUE</code> . In this case the functions produce a matrix giving the sample percentages for each interval
<code>plot</code>	whether to plot the centiles. This option is usefull if the sample statistics only are to be used
<code>...</code>	for extra arguments

Value

Centile plots are produced and the sample centiles below each centile curve for each of the *r* ranges of *x* can be saved into a matrix.

Warning

This function is appropriate when only one continuous explanatory variable is fitted in the model

Author(s)

Mikis Stasinopoulos, <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>, with contributions from Elaine Borghie

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2003) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss centiles](#), [centiles.com](#)

Examples

```
data(abdom)
h<-gamlss(y~cs(x,df=3), sigma.formula=~cs(x,1), family=BCT, data=abdom)
mout <- centiles.split(h,xvar=abdom$x)
mout
rm(h,mout)
```

coef.gamlss

Extract Model Coefficients in a GAMLSS fitted model

Description

coef.gamlss is the GAMLSS specific method for the generic function coef which extracts model coefficients from objects returned by modelling functions. 'coefficients' is an alias for coef.

Usage

```
## S3 method for class 'gamlss':
coef(object, what = c("mu", "sigma", "nu", "tau"), ... )
```

Arguments

object a GAMLSS fitted model
 what which parameter coefficient is required, default `what="mu"`
 ... for extra arguments

Value

Coefficients extracted from the GAMLSS model object.

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>

References

RRigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [deviance.gamlss](#), [fitted.gamlss](#)

Examples

```
data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
coef(h)
rm(h)
```

 cs

Specify a Smoothing Cubic Spline Fit in a GAMLSS Formula

Description

The functions `cs()`, `scs()` and `vc` are using cubic smoothing splines. They take a vector and return it with several attributes. The vector is used in the construction of the model matrix. The functions do no smoothing, but assigns the attributes to the vector to aid `gamlss` in the smoothing. The function doing the smoothing are `gamlss.cs()`, `gamlss.scs()` and `gamlss.vc()`. The `gamlss.cs()` is a modified version of the R function `smooth.spline()` which is used by the backfitting function `additive.fit`. The function `gamlss.scs()` just uses `smooth.spline()`.

It differs from the function `cs()` in that allows cross validation of the smoothing parameters. The (experimental) function `vc` can be used to fit varying coefficient models, see Hastie and Tibshirani (1993).

Usage

```
cs(x, df = 3, spar = NULL, c.spar = NULL)
vc(r, x, df = 3, spar = NULL, c.spar = NULL)
scs(x, df = NULL, spar = NULL, control.spar = NULL, all.knots = TRUE, nknots = NULL)
```

Arguments

<code>x</code>	the univariate predictor, (or expression, that evaluates to a numeric vector). For the function <code>vc</code> the <code>x</code> argument is the vector which has its (linear) coefficient change with <code>r</code>
<code>df</code>	the desired equivalent number of degrees of freedom (trace of the smoother matrix minus two for the constant and linear fit). The real smoothing parameter (<code>spar</code> below) is found such that $df = \text{tr}(S) - 2$, where S is the implicit smoother matrix. Values for <code>df</code> should be greater than 0, with 0 implying a linear fit.
<code>spar</code>	smoothing parameter, typically (but not necessarily) in (0,1]. The coefficient lambda of the integral of the squared second derivative in the fit (penalized log likelihood) criterion is a monotone function of 'spar', see the details in <code>smooth.spline</code> .
<code>c.spar</code>	This is an option to be used when the degrees of freedom of the fitted <code>gamlss</code> object are different from the ones given as input in the option <code>df</code> . The default values used are the ones given the option <code>control.spar</code> in the R function <code>smooth.spline()</code> and they are <code>c.spar=c(-1.5, 2)</code> . For very large data sets e.g. 10000 observations, the upper limit may have to increase for example to <code>c.spar=c(-1.5, 2.5)</code> . Use this option if you have received the warning 'The output df are different from the input, change the control.spar'. <code>c.spar</code> can take both vectors or lists of length 2, for example <code>c.spar=c(-1.5, 2.5)</code> or <code>c.spar=list(-1.5, 2.5)</code> would have the same effect.
<code>r</code>	for the function <code>vc</code> , <code>r</code> represent the vector of the explanatory variable which effects the coefficients of <code>x</code> i.e. $\beta(r)*x$. Both the <code>x</code> and <code>r</code> vectors should be adjusted by subtracting their mean
<code>control.spar</code>	see above <code>c.spar</code> or the equivalent argument in the function <code>smooth.spline</code> .
<code>all.knots</code>	if TRUE, all distinct points in <code>x</code> are used as knots. If FALSE (default), a subset of <code>x</code> is used, see the same argument for function <code>smooth.spline</code>
<code>nknots</code>	integer giving the number of knots to use when <code>all.knots=FALSE</code> . Per default, this is less than <code>n</code> , the number of unique <code>x</code> values for $n > 49$
<code>penalty</code>	the penalty applied to cross validation

Details

Note that `cs` itself does no smoothing; it simply sets things up for the function `gamlss()` which in turn uses the function `additive.fit()` for backfitting which in turn uses `gamlss.cs()`

Note that `cs()` and `s()` functions behave differently at their default values that is if `df` and `lambda` are not specified. `cs(x)` by default will use 3 extra degrees of freedom for smoothing for `x`. `ps(x)` by default will estimate `lambda` (and the degrees of freedom) automatically using generalised cross validation (GCV). Note that if GCV is used the convergence of the `gamlss` model can be less stable compared to a model where the degrees of freedom are fixed. This can be true especially for small data sets.

Value

the vector `x` is returned, endowed with a number of attributes. The vector itself is used in the construction of the model matrix, while the attributes are needed for the backfitting algorithms `additive.fit()`. Since smoothing splines includes linear fits, the linear part will be efficiently computed with the other parametric linear parts of the model.

Warning

For a user who wishes to compare the `gamlss()` results with the equivalent `gam()` results in S-plus: make sure when using S-plus that the convergence criteria `epsilon` and `bf.epsilon` in `control.gam()` are decreased sufficiently to ensure proper convergence in S-plus. Also note that the degrees of freedom are defined on top of the linear term in `gamlss`, but on top of the constant term in S-plus, (so use an extra degrees of freedom in S-plus in order to obtain comparable results to those in `galmss`).

Change the upper limit of `spar` if you received the warning 'The output `df` are different from the input, change the `control.spar`'.

For large data sets do not use expressions, e.g. `cs(x^0.5)` inside the `gamlss` function command but evaluate the expression, e.g. `nx=x^0.5`, first and then use `cs(nx)`.

Note

The degrees of freedom `df` are defined differently from that of the `gam()` function in S-plus. Here `df` are the additional degrees of freedom excluding the constant and the linear part of `x`. For example `df=4` in `gamlss()` is equivalent to `df=5` in `gam()` in S-plus

Author(s)

Mikis Stasinopoulos and Bob Rigby

References

Hastie, T. J. and Tibshirani, R. J. (1993), Varying coefficient models (with discussion), *J. R. Statist. Soc. B.*, **55**, 757-796.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [gamlss.cs](#), [lo](#)

Examples

```
# cubic splines example
data(aids)
# fitting a smoothing cubic spline with 7 degrees of freedom
# plus the a quarterly effect
aids1<-gamlss(y~cs(x,df=7)+qrt,data=aids,family=PO) #
aids2<-gamlss(y~scs(x,df=5)+qrt,data=aids,family=PO) #
aids3<-gamlss(y~scs(x)+qrt,data=aids,family=PO) # using GCV
with(aids, plot(x,y))
lines(aids$x,fitted(aids1), col="red")
lines(aids$x,fitted(aids3), col="green")
rm(aids1, aids2, aids3)
# varying-coefficient example
data(rent)
attach(rent)
# adjusting the variables
Flbar<-Fl-mean(Fl)
Abar<-A-mean(A)
# additive model
m1<-gamlss(R~cs(Flbar, df=3)+cs(Abar))
# varying-coefficient model
m2<-gamlss(R~cs(Flbar, df=3)+cs(Abar)+vc(r=Abar, x=Flbar))
AIC(m1,m2)
detach(rent)
```

deviance.gamlss *Global Deviance of a GAMLSS model*

Description

Returns the global, $-2 \cdot \log(\text{likelihood})$, or the penalized, $-2 \cdot \log(\text{likelihood}) + \text{penalties}$, deviance of a fitted GAMLSS model object.

Usage

```
## S3 method for class 'gamlss':
deviance(object, what = c("G", "P"), ...)
```

Arguments

object	a GAMLSS fitted model
what	put "G" for Global or "P" for Penalized deviance
...	for extra arguments

Details

deviance is a generic function which can be used to extract deviances for fitted models. `deviance.gamlss` is the method for a GAMLSS object.

Value

The value of the global or the penalized deviance extracted from a GAMLSS object.

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk)

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss.family](#), [coef.gamlss](#), [fitted.gamlss](#)

Examples

```
data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
deviance(h)
rm(h)
```

find.hyper

A function to select values of hyperparameters in a GAMLSS model

Description

This function selects the values of hyper parameters and/or non-linear parameters in a GAMLSS model. It uses the R function `optim` which then minimised the generalized Akaike information criterion (GAIC) with a user defined penalty.

Usage

```
find.hyper(model = NULL, parameters = NULL, other = NULL, penalty = 2,
           steps = c(0.1), lower = -Inf, upper = Inf, method = "L-BFGS-B",
           ...)
```

Arguments

model	this is a GAMLSS model. e.g. <code>model=gamlss(y~cs(x, df=p[1]), sigma.fo~cs(x, df=p[2]), data=abdom)</code> where p[1] and p[2] denote the parameters to be estimated
parameters	the starting values in the search of the optimum hyperparameters and/or non-linear parameters e.g. <code>parameters=c(3, 3)</code>
other	this is used to optimize other non-parameters, for example a transformation of the explanatory variable of the kind $x^{p[3]}$, <code>others=quote(nx<-x^p[3])</code> where nx is now in the model formula
penalty	specifies the penalty in the GAIC, (the default is 2 e.g. <code>penalty=3</code>)
steps	the steps taken in the optimization procedure [see the <code>ndeps</code> option in <code>optim()</code>], by default is set to 0.1 for all hyper parameters and non-linear parameters
lower	the lower permissible level of the parameters i.e. <code>lower=c(1, 1)</code> this does not apply if a method other than the default method "L-BFGS-B" is used
upper	the upper permissible level of the parameters i.e. <code>upper=c(30, 10)</code> , this does not apply if a method other than the default method "L-BFGS-B" is used
method	the method used in <code>optim()</code> to numerically minimize the GAIC over the hyperparameters and/or non-linear parameters. By default this is "L-BFGS-B" to allow box-restriction on the parameters
...	for extra arguments to be passed to the R function <code>optim()</code> used in the optimization

Details

This is an experimental function which appears to work well for the search of the optimum degrees of freedom and non-linear parameters (e.g. power parameter λ used to transform x to x^λ). Further investigation will check whether this function is reliable in general.

Value

The function turns the same output as the function `optim()`

par	the optimum hyperparameter values
value	the minimized value of the GAIC
counts	A two-element integer vector giving the number of calls to 'fn' and 'gr' respectively
convergence	An integer code. '0' indicates successful convergence. see the function <code>optim()</code> for other errors
message	A character string giving any additional information returned by the optimizer, or 'NULL'

Warning

It may be slow to find the optimum

Author(s)

Mikis Stasinopoulos

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [plot.gamlss](#), [optim](#)

Examples

```
data(abdom)
attach(abdom)
# declare the model
mod1<-quote(gamlss(y~cs(nx,df=p[1]),family=BCT,data=abdom,
                    control=gamlss.control(trace=FALSE)))
# we want also to check for a transformation in x
# so we use the other option
op<-find.hyper(model=mod1, other=quote(nx<-x^p[2]), parameters=c(3,0.5),
               lower=c(1,0.001), steps=c(0.1,0.001))
# the optimum parameters found are
# p=(p[1],p[2]) = (2.944836 0.001000) = (df for mu, lambda)
# so it needs df = 3 on top of the constant and linear
# in the cubic spline model for mu since p[1] is approximately 3
# and log transformation for x since p[2] is approximately 0
op
rm(op)
```

fitted.gamlss

Extract Fitted Values For A GAMLSS Model

Description

fitted.gamlss is the GAMLSS specific method for the generic function fitted which extracts fitted values for a specified parameter from a GAMLSS objects. fitted.values is an alias for it. The function fv() is similar to fitted.gamlss() but allows the argument what not to be character

Usage

```
## S3 method for class 'gamlss':  
fitted(object, what = c("mu", "sigma", "nu", "tau"), ...)  
fv(obj, what = "mu", ...)
```

Arguments

object	a GAMLSS fitted model
obj	a GAMLSS fitted model
what	which parameter fitted values are required, default what="mu"
...	for extra arguments

Value

Fitted values extracted from the GAMLSS object for the given parameter.

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[print.gamlss](#), [summary.gamlss](#), [fitted.gamlss](#), [coef.gamlss](#), [residuals.gamlss](#), [update.gamlss](#), [plot.gamlss](#), [deviance.gamlss](#), [formula.gamlss](#)

Examples

```
data(aids)  
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #  
fitted(h)  
rm(h)
```

fitted.plot

*Plots The Fitted Values of a GAMLSS Model***Description**

This function, applicable only to a models with a single explanatory variable, plots the fitted values for all the parameters of a GAMLSS model against the (one) explanatory variable. It is also useful for comparing the fits for more than one model.

Usage

```
fitted.plot(object, ..., x = NULL, color = TRUE, line.type = FALSE)
```

Arguments

object	a fitted GAMLSS model object(with only one explanatory variable)
...	optionally more fitted GAMLSS model objects
x	The unique explanatory variable
color	whether the fitted lines plots are shown in colour, <code>color=TRUE</code> (the default) or not <code>color=FALSE</code>
line.type	whether the line type should be different or not. The default is <code>color=FALSE</code>

Value

A plot of the fitted values against the explanatory variable

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk) and Calliope Akantziliotou

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [centiles](#), [centiles.split](#)

Examples

```
data(abdom)
h1<-gamlss(y~cs(x,df=3), sigma.formula=~x, family=BCT, data=abdom)
h2<-gamlss(y~cs(x,df=3), sigma.formula=~cs(x,df=3), family=BCT, data=abdom)
fitted.plot(h1,h2,x=abdom$x)
rm(h1,h2)
```

formula.gamlss	<i>Extract the Model Formula in a GAMLSS fitted model</i>
----------------	---

Description

formula.gamlss is the GAMLSS specific method for the generic function formula which extracts the model formula from objects returned by modelling functions.

Usage

```
## S3 method for class 'gamlss':
formula(x, what = c("mu", "sigma", "nu", "tau"), ... )
```

Arguments

x	a GAMLSS fitted model
what	which parameter coefficient is required, default what="mu"
...	for extra arguments

Value

Returns a model formula

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [deviance.gamlss](#), [fitted.gamlss](#)

Examples

```
data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
formula(h, "mu")
rm(h)
```

gamlss

Generalized Additive Models for Location Scale and Shape

Description

Returns an object of class "gamlss", which is a generalized additive model for location scale and shape (GAMLSS). The function `gamlss()` is very similar to the `gam()` function in S-plus (now also in R in package `gam`), but can fit more distributions (not only the ones belonging to the exponential family) and can model all the parameters of the distribution as functions of the explanatory variables (e.g. using linear, non-linear, smoothing, loess and random effects terms).

This implementation of `gamlss()` allows modelling of up to four parameters in a distribution family, which are conventionally called `mu`, `sigma`, `nu` and `tau`.

The function `gamlssNews()` shows what is new in the current implementation.

Usage

```
gamlss(formula = formula(data), sigma.formula = ~1,
       nu.formula = ~1, tau.formula = ~1, family = NO(),
       data = sys.parent(), weights = NULL,
       contrasts = NULL, method = RS(), start.from = NULL,
       mu.start = NULL, sigma.start = NULL,
       nu.start = NULL, tau.start = NULL,
       mu.fix = FALSE, sigma.fix = FALSE, nu.fix = FALSE,
       tau.fix = FALSE, control = gamlss.control(...),
       i.control = glim.control(...), ...)
is.gamlss(x)
gamlssNews()
```

Arguments

`formula` a formula object, with the response on the left of an `~` operator, and the terms, separated by `+` operators, on the right. Nonparametric smoothing terms are indicated by `cs` for smoothing splines, `lo` for loess smooth terms and `random` or `ra` for random terms, e.g. `y~cs(x, df=5)+x1+x2*x3`. Additional smoothers can be added by creating the appropriate interface. Interactions with nonparametric smooth terms are not fully supported, but will not produce errors; they will simply produce the usual parametric interaction

<code>sigma.formula</code>	a formula object for fitting a model to the <code>sigma</code> parameter, as in the formula above, e.g. <code>sigma.formula=~cs(x, df=5)</code> . It can be abbreviated to <code>sigma.fo=~cs(x, df=5)</code> .
<code>nu.formula</code>	a formula object for fitting a model to the <code>nu</code> parameter, e.g. <code>nu.fo=~x</code>
<code>tau.formula</code>	a formula object for fitting a model to the <code>tau</code> parameter, e.g. <code>tau.fo=~cs(x, df=2)</code>
<code>family</code>	a <code>gamlss.family</code> object, which is used to define the distribution and the link functions of the various parameters. The distribution families supported by <code>gamlss()</code> can be found in <code>gamlss.family</code> . Functions such as <code>BI()</code> (binomial) produce a family object. Also can be given without the parentheses i.e. <code>BI</code> . Family functions can take arguments, as in <code>BI(mu.link=probit)</code>
<code>data</code>	a data frame containing the variables occurring in the formula. If this is missing, the variables should be on the search list. e.g. <code>data=aids</code>
<code>weights</code>	a vector of weights. Note that this is not the same as in the <code>glm()</code> or <code>gam()</code> function. Here weights can be used to weight out observations (like in <code>subset</code>) or for a weighted likelihood analysis where the contribution of the observations to the likelihood differs according to <code>weights</code> . The length of <code>weights</code> must be the same as the number of observations in the data. By default, the weight is set to one. To set weights to vector <code>w</code> use <code>weights=w</code>
<code>contrasts</code>	list of contrasts to be used for some or all of the factors appearing as variables in the model formula. The names of the list should be the names of the corresponding variables. The elements should either be contrast-type matrices (matrices with as many rows as levels of the factor and with columns linearly independent of each other and of a column of ones), or else they should be functions that compute such contrast matrices.
<code>method</code>	the current algorithms for GAMLSS are <code>RS()</code> , <code>CG()</code> and <code>mixed()</code> . i.e. <code>method=RS()</code> will use the Rigby and Stasinopoulos algorithm, <code>method=CG()</code> will use the Cole and Green algorithm and <code>mixed(2, 10)</code> will use the RS algorithm twice before switching to the Cole and Green algorithm for up to 10 extra iterations
<code>start.from</code>	a fitted GAMLSS model which the fitted values will be used as starting values for the current model
<code>mu.start</code>	vector or scalar of initial values for the location parameter <code>mu</code> e.g. <code>mu.start=4</code>
<code>sigma.start</code>	vector or scalar of initial values for the scale parameter <code>sigma</code> e.g. <code>sigma.start=1</code>
<code>nu.start</code>	vector or scalar of initial values for the parameter <code>nu</code> e.g. <code>nu.start=3</code>
<code>tau.start</code>	vector or scalar of initial values for the location parameter <code>tau</code> e.g. <code>tau.start=2</code>
<code>mu.fix</code>	whether the <code>mu</code> parameter should be kept fixed in the fitting processes e.g. <code>mu.fix=FALSE</code>
<code>sigma.fix</code>	whether the <code>sigma</code> parameter should be kept fixed in the fitting processes e.g. <code>sigma.fix=FALSE</code>
<code>nu.fix</code>	whether the <code>nu</code> parameter should be kept fixed in the fitting processes e.g. <code>nu.fix=FALSE</code>
<code>tau.fix</code>	whether the <code>tau</code> parameter should be kept fixed in the fitting processes e.g. <code>tau.fix=FALSE</code>
<code>control</code>	this sets the control parameters of the outer iterations algorithm. The default setting is the <code>gamlss.control</code> function

<code>i.control</code>	this sets the control parameters of the inner iterations of the RS algorithm. The default setting is the <code>glim.control</code> function
<code>...</code>	for extra arguments
<code>x</code>	an object

Details

The Generalized Additive Model for Location, Scale and Shape is a general class of statistical models for a univariate response variable. The model assumes independent observations of the response variable y given the parameters, the explanatory variables and the values of the random effects. The distribution for the response variable in the GAMLSS can be selected from a very general family of distributions including highly skew and/or kurtotic continuous and discrete distributions, see `gamlss.family`. The systematic part of the model is expanded to allow modelling not only of the mean (or location) parameter, but also of the other parameters of the distribution of y , as linear parametric and/or additive nonparametric (smooth) functions of explanatory variables and/or random effects terms. Maximum (penalized) likelihood estimation is used to fit the (non)parametric models. A Newton-Raphson/Fisher scoring algorithm is used to maximize the (penalized) likelihood. The additive terms in the model are fitted using a backfitting algorithm.

`is.gamlss` is a short version is `is(object, "gamlss")`

Value

Returns a `gamlss` object with components

<code>family</code>	the distribution family of the <code>gamlss</code> object (see <code>gamlss.family</code>)
<code>parameters</code>	the name of the fitted parameters i.e. mu , sigma , nu , tau
<code>call</code>	the call of the <code>gamlss</code> function
<code>y</code>	the response variable
<code>control</code>	the <code>gamlss</code> fit control settings
<code>weights</code>	the vector of weights
<code>G.deviance</code>	the global deviance
<code>N</code>	the number of observations in the fit
<code>rqres</code>	a function to calculate the normalized (randomized) quantile residuals of the object
<code>iter</code>	the number of external iterations in the fitting process
<code>type</code>	the type of the distribution or the response variable (continuous or discrete)
<code>method</code>	which algorithm is used for the fit, <code>RS()</code> , <code>CG()</code> or <code>mixed()</code>
<code>converged</code>	whether the model fitting has have converged
<code>residuals</code>	the normalized (randomized) quantile residuals of the model
<code>mu.fv</code>	the fitted values of the μ model, also <code>sigma.fv</code> , <code>nu.fv</code> , <code>tau.fv</code> for the other parameters if present
<code>mu.lp</code>	the linear predictor of the μ model, also <code>sigma.lp</code> , <code>nu.lp</code> , <code>tau.lp</code> for the other parameters if present

<code>mu.wv</code>	the working variable of the mu model, also <code>sigma.wv</code> , <code>nu.wv</code> , <code>tau.wv</code> for the other parameters if present
<code>mu.wt</code>	the working weights of the mu model, also <code>sigma.wt</code> , <code>nu.wt</code> , <code>tau.wt</code> for the other parameters if present
<code>mu.link</code>	the link function for the mu model, also <code>sigma.link</code> , <code>nu.link</code> , <code>tau.link</code> for the other parameters if present
<code>mu.terms</code>	the terms for the mu model, also <code>sigma.terms</code> , <code>nu.terms</code> , <code>tau.terms</code> for the other parameters if present
<code>mu.x</code>	the design matrix for the mu, also <code>sigma.x</code> , <code>nu.x</code> , <code>tau.x</code> for the other parameters if present
<code>mu.qr</code>	the QR decomposition of the mu model, also <code>sigma.qr</code> , <code>nu.qr</code> , <code>tau.qr</code> for the other parameters if present
<code>mu.coefficients</code>	the linear coefficients of the mu model, also <code>sigma.coefficients</code> , <code>nu.coefficients</code> , <code>tau.coefficients</code> for the other parameters if present
<code>mu.formula</code>	the formula for the mu model, also <code>sigma.formula</code> , <code>nu.formula</code> , <code>tau.formula</code> for the other parameters if present
<code>mu.df</code>	the mu degrees of freedom also <code>sigma.df</code> , <code>nu.df</code> , <code>tau.df</code> for the other parameters if present
<code>mu.nl.df</code>	the non linear degrees of freedom, also <code>sigma.nl.df</code> , <code>nu.nl.df</code> , <code>tau.nl.df</code> for the other parameters if present
<code>df.fit</code>	the total degrees of freedom use by the model
<code>df.residual</code>	the residual degrees of freedom left after the model is fitted
<code>aic</code>	the Akaike information criterion
<code>sbc</code>	the Bayesian information criterion

Warning

Respect the parameter hierarchy when you are fitting a model. For example a good model for `mu` should be fitted before a model for `sigma` is fitted

Note

The following generic functions can be used with a GAMLSS object: `print`, `summary`, `fitted`, `coef`, `residuals`, `update`, `plot`, `deviance`, `formula`

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk) and Calliope Akantziliotou

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.londonmet.ac.uk/gamlss/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss.family](#), [pdf.plot](#), [find.hyper](#)

Examples

```
data(abdom)
mod<-gamlss(y~cs(x,df=3),sigma.fo=~cs(x,df=1),family=BCT, data=abdom, method=mixed(1,20))
plot(mod)
rm(mod)
```

`gamlss.control`

Auxiliary for Controlling GAMLSS Fitting

Description

Auxiliary function as user interface for `gamlss` fitting. Typically only used when calling `gamlss` function with the option `control`.

Usage

```
gamlss.control(c.crit = 0.001, n.cyc = 20, mu.step = 1, sigma.step = 1, nu.step = 1,
              tau.step = 1, gd.tol = 5, iter = 0, trace = TRUE, autostep = TRUE,
              save = TRUE, ...)
```

Arguments

<code>c.crit</code>	the convergence criterion for the algorithm
<code>n.cyc</code>	the number of cycles of the algorithm
<code>mu.step</code>	the step length for the parameter <code>mu</code>
<code>sigma.step</code>	the step length for the parameter <code>sigma</code>
<code>nu.step</code>	the step length for the parameter <code>nu</code>
<code>tau.step</code>	the step length for the parameter <code>tau</code>
<code>gd.tol</code>	global deviance tolerance level

<code>iter</code>	starting value for the number of iterations, typically set to 0 unless the function <code>refit</code> is used
<code>trace</code>	whether to print at each iteration (TRUE) or not (FALSE)
<code>autostep</code>	whether the steps should be halved automatically if the new global deviance is greater than the old one, the default is <code>autostep=TRUE</code>
<code>save</code>	<code>save=TRUE</code> , (the default), saves all the information on exit. <code>save=FALSE</code> saves only limited information as the global deviance and AIC. For example fitted values, design matrices and additive terms are not saved. The latest is useful when <code>gamlss()</code> is called several times within a procedure.
<code>...</code>	for extra arguments

Details

The step length for each of the parameters `mu`, `sigma`, `nu` or `tau` is very useful to aid convergence if the parameter has a fully parametric model. However using a step length is not theoretically justified if the model for the parameter includes one or more smoothing terms, (even though it may give a very approximate result).

The `c.crit` can be increased to speed up the convergence especially for a large set of data which takes longer to fit. When 'trace' is TRUE, calls to the function `cat` produce the output for each outer iteration.

Value

A list with the arguments as components.

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

Examples

```

data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
con<-gamlss.control(mu.step=0.1)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids, control=con) #
rm(h,con)

```

gamlss.cs

*Support for Function cs(), s() and vc()***Description**

This is support for the functions `cs()`, `s()` and `vc()`. It is not intended to be called directly by users. The function `gamlss.cs` is based on the R function `smooth.spline`

Usage

```

gamlss.cs(x, y = NULL, w = NULL, df = 5, spar = NULL, cv = FALSE, nknots = NULL,
          all.knots = TRUE, df.offset = 0, penalty = 1,
          control.spar = list(low = -1.5, high = 2), xeval = NULL)
gamlss.scs(x, y = NULL, w = NULL, df = NULL, spar = NULL, cv = FALSE, all.knots = F,
           nknots = NULL, keep.data = TRUE, df.offset = 0, penalty = 1.4,
           control.spar = list(low = -1.5, high = 2), xeval = NULL)
gamlss.vc(x, y = NULL, w = NULL, df = 5, spar = NULL, cv = FALSE, all.knots = TRUE,
          df.offset = 0, penalty = 1, control.spar = list(low = -1.5, high = 2),
          xeval = NULL)

```

Arguments

<code>x</code>	the design matrix
<code>y</code>	the response variable
<code>w</code>	prior weights
<code>df</code>	effective degrees of freedom
<code>spar</code>	spar the smoothing parameter
<code>cv</code>	options for the <code>smooth.spline</code> function not to use here
<code>nknots</code>	options for the <code>smooth.spline</code> function not to use here
<code>all.knots</code>	options for the <code>smooth.spline</code> function not to use here
<code>df.offset</code>	options for the <code>smooth.spline</code> function not to use here
<code>keep.data</code>	whether to keep data
<code>penalty</code>	options for the <code>smooth.spline</code> function not to use here
<code>control.spar</code>	control for spar. It can be changed through <code>cs</code>
<code>xeval</code>	used in prediction

Value

Returns a class "smooth.spline" object with

<code>residuals</code>	The residuals of the fit
<code>fitted.values</code>	The smoothing values
<code>var</code>	the variance for the fitted smoother
<code>lambda</code>	the final value for spar
<code>nl.df</code>	the smoothing degrees of freedom excluding the constant and linear terms, i.e. (df-2)
<code>coefSmo</code>	this is a list containing among others the knots and the coefficients
<code>...</code>	

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk)

See Also

[gamlss, cs](#)

`gamlss.fp`

Support for Function fp()

Description

Those are support for the functions `fp()` and `pp()`. It is not intended to be called directly by users.

Usage

```
gamlss.fp(x, y, w, npoly = 2, xeval = NULL)
gamlss.pp(x, y, w)
```

Arguments

<code>x</code>	the <code>x</code> for function <code>gamlss.fp</code> is referred to the design matrix of the specific parameter model (not to be used by the user)
<code>y</code>	the <code>y</code> for function <code>gamlss.fp</code> is referred to the working variable of the specific parameter model (not to be used by the user)
<code>w</code>	the <code>w</code> for function <code>gamlss.fp</code> is referred to the iterative weight variable of the specific parameter model (not to be used by the user)
<code>npoly</code>	a positive indicating how many fractional polynomials should be considered in the fit. Can take the values 1, 2 or 3 with 2 as default
<code>xeval</code>	used in prediction

Value

Returns a list with

<code>fitted.values</code>	<code>fitted</code>
<code>residuals</code>	<code>residuals</code>
<code>var</code>	
<code>nl.df</code>	the trace of the smoothing matrix
<code>lambda</code>	the value of the smoothing parameter
<code>coefSmo</code>	the coefficients from the smoothing fit
<code>varcoeff</code>	the variance of the coefficients

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss, fp](#)

gamlss.lo

Support for Function lo()

Description

This is support for the `loess` function `lo()`. It is not intended to be called directly by users. The function `gamlss.lo` is based on the R function `loess`

Usage

```
gamlss.lo(x, y, w = NULL, span, df = NULL, degree = 1, ncols =
  FALSE, wspan = TRUE, parametric = FALSE, drop.square
  = FALSE, normalize = FALSE, family = "gaussian",
  method = "loess", control = loess.control(...), xeval
  = NULL, ...)
```

Arguments

x	the design matrix
y	the response variable
w	prior weights
span	the smoothing parameter
df	effective degrees of freedom
degree	the order of the polynomial
ncols	the number of columns of the x matrix
wspan	argument for the loess function not to use here
parametric	argument for the loess function not to use here
drop.square	argument for the loess function not to use here
normalize	argument for the loess function not to use here
family	argument for the loess function not to use here
method	argument for the loess function not to use here
control	argument for the loess function not to use here
xeval	used in prediction
...	further arguments passed to or from other methods.

Value

Returns an object with

fitted	the smooth values
residuals	the residuals
var	the variance of the smoother
nl.df	the non-linear degrees of freedom
coefSmo	with value NULL
lambda	the value of span

Author(s)

Mikis Stasinopoulos based on Brian Ripley loess function in R

See Also

[gamlss, lo](#)

gamlss.ps

*Support for Functions ps(), pb(), cy() and ri()***Description**

Those functions are support for the functions `ps()` and `pb()`. The functions are not intended to be called directly by users.

Usage

```
gamlss.ps(x, y, w, xeval = NULL, ...)
gamlss.pb(x, y, w, xeval = NULL, ...)
gamlss.ridge(x, y, w, xeval = NULL, ...)
gamlss.ri(x, y, w, xeval = NULL, ...)
gamlss.cy(x, y, w, xeval = NULL, ...)
```

Arguments

<code>x</code>	the <code>x</code> for function <code>gamlss.fp</code> is referred to the design matrix of the specific parameter model (not to be used by the user)
<code>y</code>	the <code>y</code> for function <code>gamlss.fp</code> is referred to the working variable of the specific parameter model (not to be used by the user)
<code>w</code>	the <code>w</code> for function <code>gamlss.fp</code> is referred to the iterative weight variable of the specific parameter model (not to be used by the user)
<code>xeval</code>	used in prediction
<code>...</code>	further arguments passed to or from other methods.

Value

<code>comp1</code>	Description of 'comp1'
<code>comp2</code>	Description of 'comp2'
<code>...</code>	

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2003) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [ps](#), [pb](#)

gamlss.ra

Support for Function ra()

Description

This is support for the random effect smoother function `ra()`. It is not intended to be called directly by users. The function `gamlss.ra` is similar to the GAMLSS function `gamlss.random`. Both functions can be used with the same effect.

Usage

```
gamlss.ra(x, y, w, df = NULL)
```

Arguments

<code>x</code>	the explanatory design matrix
<code>y</code>	the response variable
<code>w</code>	iterative weights
<code>df</code>	effective degrees of freedom

Value

Returns an list with

<code>fitted.values</code>	fitted values
<code>residuals</code>	residuals
<code>var</code>	variances of the fitted values
<code>nl.df</code>	the trace of the smoothing matrix
<code>lambda</code>	the value of the smoothing parameter
<code>coefSmo</code>	the coefficients from the smoothing fit
<code>varcoeff</code>	the variance of the coefficients

Note

This is an experimental function and should be used with care

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

RRigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [ra](#), [random](#)

`gamlss.random` *Support for Function random()*

Description

This is support for the function `random()`. It is not intended to be called directly by users. The function `gamlss.random` is similar to the GAMLSS function `gamlss.ra`.

Usage

```
gamlss.random(x, y, w, df = NULL, lambda = 0)
```

Arguments

<code>x</code>	the explanatory design matrix
<code>y</code>	the response variable
<code>w</code>	iterative weights
<code>df</code>	effective degrees of freedom
<code>lambda</code>	the smoothing parameter

Value

Returns a list with

<code>y</code>	the fitted values
<code>residuals</code>	the residuals
<code>var</code>	the variance of the fitted values
<code>lambda</code>	the final lambda, the smoothing parameter
<code>coefSmo</code>	with value NULL

Author(s)

Mikis Stasinopoulos, based on Trevor Hastie function `gam.random`

References

Chambers, J. M. and Hastie, T. J. (1991). *Statistical Models in S*, Chapman and Hall, London.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [random](#), [ra](#)

`gamlss.rc`

Support for Function rc()

Description

This is support for the function `rc()`. It is not intended to be called directly by users.

Usage

```
gamlss.rc(x, y, w, df = NULL)
```

Arguments

<code>x</code>	the explanatory design matrix
<code>y</code>	the response variable
<code>w</code>	iterative weights
<code>df</code>	effective degrees of freedom

Value

Returns a list with

`fitted.values`

`fitted`

`residuals` `residuals`

`var`

<code>nl.df</code>	the trace of the smoothing matrix
<code>lambda</code>	the value of the smoothing parameter
<code>coefSmo</code>	the coefficients from the smoothing fit
<code>varcoeff</code>	the variance of the coefficients

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss, rc](#)

<code>gamlss.scope</code>	<i>Generate a Scope Argument for Stepwise GAMLSS</i>
---------------------------	--

Description

Generates a scope argument for a stepwise GAMLSS.

Usage

```
gamlss.scope(frame, response = 1, smoother = "cs", arg = NULL, form = TRUE)
```

Arguments

<code>frame</code>	a data or model frame
<code>response</code>	which variable is the response; the default is the first
<code>smoother</code>	what smoother to use; default is <code>cs</code>
<code>arg</code>	any additional arguments required by the smoother
<code>form</code>	should a formula be returned (default), or else a character version of the formula

Details

Each formula describes an ordered regimen of terms, each of which is eligible on their own for inclusion in the gam model. One of the terms is selected from each formula by step.gam. If a 1 is selected, that term is omitted.

Value

a list of formulas is returned, one for each column in frame (excluding the response). For a numeric variable, say x_1 , the formula is

$$\sim 1 + x_1 + \text{cs}(x_1)$$

If x_1 is a factor, the last smooth term is omitted.

Author(s)

Mikis Stasinopoulos: a modified function from Statistical Models in S

References

Chambers, J. M. and Hastie, T. J. (1991). *Statistical Models in S*, Chapman and Hall, London.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[stepGAIC](#)

Examples

```
data(usair)
gs1<-gamlss.scope(model.frame(y~x1+x2+x3+x4+x5+x6, data=usair))
gs2<-gamlss.scope(model.frame(usair))
gs1
gs2
gs3<-gamlss.scope(model.frame(usair), smooth="fp", arg="3")
gs3
```

glim.control *Auxiliary for Controlling the inner algorithm in a GAMLSS Fitting*

Description

Auxiliary function used for the inner iteration of `gamlss` algorithm. Typically only used when calling `gamlss` function through the option `i.control`.

Usage

```
glim.control(cc = 0.001, cyc = 50, glm.trace = FALSE,
            bf.cyc = 30, bf.tol = 0.001, bf.trace = FALSE,
            ...)
```

Arguments

<code>cc</code>	the convergence criterion for the algorithm
<code>cyc</code>	the number of cycles of the algorithm
<code>glm.trace</code>	whether to print at each iteration (TRUE) or not (FALSE)
<code>bf.cyc</code>	the number of cycles of the backfitting algorithm
<code>bf.tol</code>	the convergence criterion (tolerance level) for the backfitting algorithm
<code>bf.trace</code>	whether to print at each iteration (TRUE) or not (FALSE, the default)
<code>...</code>	for extra arguments

Value

A list with the arguments as components

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape, (with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

Examples

```
data(aids)
con<-glim.control(glm.trace=TRUE)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids, i.control=con) #
rm(h, con)
```

histDist	<i>This function plots the histogram and a fitted (GAMLSS family) distribution to a variable</i>
----------	--

Description

This function fits constants to the parameters of a GAMLSS family distribution and then plots the histogram and the fitted distribution.

Usage

```
histDist(y, family = NO, freq = NULL,
         density = FALSE, nbins = 10, xlim = NULL,
         ylim = NULL, main = NULL, xlab = NULL,
         ylab = NULL, ...)
```

Arguments

<code>y</code>	a vector for the response variable
<code>family</code>	a <code>gamlss.family</code> distribution
<code>freq</code>	the frequencies of the data in <code>y</code> if exist. <code>freq</code> is used as weights in the <code>gamlss</code> fit
<code>density</code>	default value is <code>FALSE</code> . Change to <code>TRUE</code> if you would like a non-parametric density plot together with the parametric fitted distribution plot (for continuous variable only)
<code>nbins</code>	The suggested number of bins (argument passed to <code>truehist()</code> of package <code>MASS</code>). Either a positive integer, or a character string naming a rule: "Scott" or "Freedman-Diaconis" or "FD". (Case is ignored.)
<code>xlim</code>	the minimum and the maximum x-axis value (if the default values are out of range)
<code>ylim</code>	the minimum and the maximum y-axis value (if the default values are out of range)
<code>main</code>	the main title for the plot
<code>xlab</code>	the label in the x-axis
<code>ylab</code>	the label in the y-axis
<code>...</code>	for extra arguments to be passed to the <code>gamlss</code> function

Details

This function first fits constants for each parameters of a GAMLSS distribution family using the `gamlss` function and then plots the fitted distribution together with the appropriate plot according to whether the `y` variable is of a continuous or discrete type. Histogram is plotted for continuous and `barplot` for discrete variables. The function `truehist` of Venables and Ripley's MASS package is used for the histogram plotting.

Value

returns a plot

Author(s)

Mikis Stasinopoulos

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [gamlss.family](#)

Examples

```
data(abdom)
attach(abdom)
histDist(y,family="NO")
# use the ymax argument of the of the truehist()
histDist(y,family="NO",ymax=0.005)
# bad fit use PE
histDist(y,family="PE",ymax=0.005)
detach(abdom)
# discere data counts
# Hand at al. p150 Leptinotarsa decemlineata
y <- c(0,1,2,3,4,6,7,8,10,11)
freq <- c(33,12,5,6,5,2,2,2,1,2)
histDist(y, "NBI", freq=freq)
# the same as
histDist(rep(y,freq), "NBI")
```

IC

*Gives the GAIC for a GAMLSS Object***Description**

IC is a function to calculate the Generalized Akaike information criterion (GAIC) for a given penalty k for a fitted GAMLSS object. The function `AIC.gamlss` is the method associated with a GAMLSS object of the generic function `AIC`. The function `GAIC` is a synonymous of the function `AIC.gamlss`. The function `extractAIC` is a the method associated a GAMLSS object of the generic function `extractAIC` and it is mainly used in the `stepAIC` function.

Usage

```
IC(object, k = 2)
## S3 method for class 'gamlss':
AIC(object, ..., k = 2)
GAIC(object, ..., k = 2 )
## S3 method for class 'gamlss':
extractAIC(fit, scale, k = 2, ...)
```

Arguments

<code>object</code>	an <code>gamlss</code> fitted model
<code>fit</code>	an <code>gamlss</code> fitted model
<code>...</code>	allows several GAMLSS object to be compared using a GAIC
<code>k</code>	the penalty with default $k=2.5$
<code>scale</code>	this argument is not used in <code>gamlss</code>

Value

The function `IC` returns the GAIC for given penalty k of the GAMLSS object. The function `AIC` returns a matrix contains the df 's and the GAIC's for given penalty k . The function `GAIC` returns identical results to `AIC`. The function `extractAIC` returns vector of length two with the degrees of freedom and the AIC criterion.

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk)

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. 23, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

Examples

```
data(abdom)
mod1<-gamlss(y~cs(x,df=3),sigma.fo=~cs(x,df=1),family=BCT, data=abdom)
IC(mod1)
mod2<-gamlss(y~cs(x,df=3),sigma.fo=~x,family=BCT, data=abdom)
AIC(mod1,mod2,k=3)
GAIC(mod1,mod2,k=3)
extractAIC(mod1,k=3)
rm(mod1,mod2)
```

lo

Specify a loess fit in a GAMLSS formula

Description

Allows the user to specify a loess fit in a GAMLSS formula. This function is similar to the `lo` function in the `gam` implementation of S-plus

Usage

```
lo(..., span = 0.5, df = NULL, degree = 1)
```

Arguments

<code>...</code>	the unspecified ... can be a comma-separated list of numeric vectors, numeric matrix, or expressions that evaluate to either of these. If it is a list of vectors, they must all have the same length.
<code>span</code>	the number of observations in a neighborhood. This is the smoothing parameter for a loess fit.
<code>df</code>	the effective degrees of freedom can be specified instead of span, e.g. <code>df=5</code>
<code>degree</code>	the degree of local polynomial to be fit; can be 1 or 2.

Details

Note that `lo` itself does no smoothing; it simply sets things up for the function `gamlss.lo()` which is used by the backfitting function `gamlss.add()`.

Value

a numeric matrix is returned. The simplest case is when there is a single argument to `lo` and `degree=1`; a one-column matrix is returned, consisting of a normalized version of the vector. If `degree=2` in this case, a two-column matrix is returned, consisting of a 2d-degree orthogonal-polynomial basis. Similarly, if there are two arguments, or the single argument is a two-column matrix, either a two-column matrix is returned if `degree=1`, or a five-column matrix consisting of powers and products up to degree 2. Any dimensional argument is allowed, but typically one or two vectors are used in practice. The matrix is endowed with a number of attributes; the matrix itself is used in the construction of the model matrix, while the attributes are needed for the backfitting algorithms `all.wam` or `lo.wam` (weighted additive model). Local-linear curve or surface fits reproduce linear responses, while local-quadratic fits reproduce quadratic curves or surfaces. These parts of the loess fit are computed exactly together with the other parametric linear parts of the model.

Warning

For user wanted to compare the `gamlss()` results with the equivalent `gam()` results in S-plus: make sure that the convergence criteria `epsilon` and `bf.epsilon` in S-plus are decreased sufficiently to ensure proper convergence in S-plus

Note

Note that `lo` itself does no smoothing; it simply sets things up for `gamlss.lo()` to do the back-fitting.

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk), based on the Trevor Hastie S-plus `lo` function

References

Chambers, J. M. and Hastie, T. J. (1991). *Statistical Models in S*, Chapman and Hall, London.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[cs](#), [random](#),

Examples

```

data(aids)
attach(aids)
# fitting a loess curve with span=0.4 plus the a quarterly effect
aids1<-gamlss(y~lo(x,span=0.4)+qrt,data=aids,family=PO) #
plot(x,y)
lines(x,fitted(aids1))
rm(aids1)
detach(aids)

```

lpred	<i>Extract Linear Predictor Values and Standard Errors For A GAMLSS Model</i>
-------	---

Description

lpred is the GAMLSS specific method which extracts the linear predictor and its (approximate) standard errors for a specified parameter from a GAMLSS objects. The lpred can be also used to extract the fitted values (with its approximate standard errors) or specific terms in the model (with its approximate standard errors) in the same way that the predict.lm() and predict.glm() functions can be used for lm or glm objects. The function lp extract only the linear predictor. If prediction is required for new data values then use the function predict.gamlss().

Usage

```

lpred(obj, what = c("mu", "sigma", "nu", "tau"),
      type = c("link", "response", "terms"),
      terms = NULL, se.fit = FALSE, ...)
lp(obj, what = "mu", ...)

```

Arguments

obj	a GAMLSS fitted model
what	which distribution parameter is required, default what="mu"
type	type="link" (the default) gets the linear predictor for the specified distribution parameter. type="response" gets the fitted values for the parameter while type="terms" gets the fitted terms contribution
terms	if type="terms", which terms to be selected (default is all terms)
se.fit	if TRUE the approximate standard errors of the appropriate type are extracted
...	for extra arguments

Value

If se.fit=FALSE a vector (or a matrix) of the appropriate type is extracted from the GAMLSS object for the given parameter in what. If se.fit=TRUE a list containing the appropriate type, fit, and its (approximate) standard errors, se.fit.

Author(s)

Mikis Stasinopoulos

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[predict.gamlss](#)

Examples

```
data(aids)
mod<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
mod.t <- lpred(mod, type = "terms", terms= "qrt")
mod.t
mod.lp <- lp(mod)
mod.lp
rm(mod, mod.t, mod.lp)
```

`model.frame.gamlss` *Extract a model.frame, a model matrix or terms from a GAMLSS object for a given distributional parameter*

Description

`model.frame.gamlss`, `model.matrix.gamlss` and `terms.gamlss` are the `gamlss` versions of the generic functions `model.frame`, `model.matrix` and `terms` respectively.

Usage

```
## S3 method for class 'gamlss':
model.frame(formula, what = c("mu", "sigma", "nu", "tau"), ...)
## S3 method for class 'gamlss':
terms(x, what = c("mu", "sigma", "nu", "tau"), ...)
## S3 method for class 'gamlss':
model.matrix(object, what = c("mu", "sigma", "nu", "tau"), ...)
```

Arguments

formula	a gamlss object
x	a gamlss object
object	a gamlss object
what	for which parameter to extract the model.frame, terms or model.frame
...	for extra arguments

Value

a model.frame, a model.matrix or terms

Author(s)

Mikis Stasinopoulos

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

Examples

```
data(aids)
mod<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
model.frame(mod)
model.matrix(mod)
terms(mod, "mu")
rm(mod)
```

`par.plot`*A function to plot parallel plot for repeated measurement data*

Description

This function can be used to plot parallel plots for each individual in a repeated measurement study. It is based on the `coplot()` function of R.

Usage

```
par.plot(formula = NULL, data = NULL, subjects = NULL,  
         color = TRUE, show.given = TRUE, ...)
```

Arguments

<code>formula</code>	a formula describing the form of conditioning plot. A formula of the form $y \sim x \mid a$ indicates that plots of y versus x should be produced conditional on the variable a . A formula of the form $y \sim x \mid a * b$ indicates that plots of y versus x should be produced conditional on the two variables a and b .
<code>data</code>	a data frame containing values for any variables in the formula. By default the environment where <code>par.plot</code> was called from is used.
<code>subjects</code>	a factor which distinguish between the individual participants
<code>color</code>	whether the parallel plot are shown in colour, <code>color=TRUE</code> (the default) or not <code>color=FALSE</code>
<code>show.given</code>	logical (possibly of length 2 for 2 conditioning variables): should conditioning plots be shown for the corresponding conditioning variables (default 'TRUE')
<code>...</code>	for extra arguments

Value

It returns a plot.

Note

Note that similar plot can be found in the library `nlme` by Pinheiro and Bates

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

Examples

```
library(nlme)
data(Orthodont)
par.plot(distance~age,data=Orthodont,sub=Subject)
par.plot(distance~age|Sex,data=Orthodont,sub=Subject)
par.plot(distance~age|Subject,data=Orthodont,sub=Subject,show.given=FALSE)
```

pdf.plot

Plots Probability Distribution Functions for GAMLSS Family

Description

A function to plot probability distribution functions (pdf) belonging to the `gamlss` family of distributions. This function allows either plotting of the fitted distributions for up to eight observations or plotting specified distributions belonging in the `gamlss` family

Usage

```
pdf.plot(obj = NULL, obs = c(1), family = NO(), mu = NULL,
         sigma = NULL, nu = NULL, tau = NULL, min = NULL,
         max = NULL, step = NULL, allinone = FALSE,
         no.title = FALSE, ...)
```

Arguments

`obj` An `gamlss` object e.g. `obj=model1` where `model1` is a fitted `gamlss` object

`obs` A number or vector of up to length eight indicating the case numbers of the observations for which fitted distributions are to be displayed, e.g. `obs=c(23, 58)` will display the fitted distribution for the 23th and 58th observations

<code>family</code>	This must be a gamlss family i.e. <code>family=NO</code>
<code>mu</code>	The value(s) of the location parameter <code>mu</code> for which the distribution has to be evaluated e.g <code>mu=c(3, 7)</code>
<code>sigma</code>	The value(s) the scale parameter <code>sigma</code> for which the distribution has to be evaluated e.g <code>sigma=c(3, 7)</code>
<code>nu</code>	The value(s) the parameter <code>nu</code> for which the distribution has to be evaluated e.g. <code>nu=3</code>
<code>tau</code>	The value(s) the parameter <code>tau</code> for which the distribution has be evaluated e.g. <code>tau=5</code>
<code>min</code>	Minimum value of the random variable <code>y</code> e.g. <code>min=0</code>
<code>max</code>	Maximum value of <code>y</code> e.g. <code>max=10</code>
<code>step</code>	Steps for the evaluation of <code>y</code> e.g. <code>step=0.5</code>
<code>allinone</code>	This will go
<code>no.title</code>	Whether you need title in the plot, default is <code>no.title=FALSE</code>
<code>...</code>	for extra arguments

Details

This function can be used to plot distributions of the GAMLSS family. If the first argument `obj` is specified and it is a GAMLSS fitted object, then the fitted distribution of this model at specified observation values (given by the second argument `obs`) is plotted for a specified y-variable range (arguments `min`, `max`, and `step`).

If the first argument is not given then the `family` argument has to be specified and the pdf is plotted at specified values of the parameters `mu`, `sigma`, `nu`, `tau`. Again the range of the y-variable has to be given.

Value

plot(s) of the required pdf(s) are returned

Warning

The range of some distributions depends on the fitted parameters

Note

The range of the y values given by `min`, `max` and `step` are very important in the plot

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk) and Calliope Akantziliotou

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

Examples

```
pdf.plot(family=BCT, min=1, max=20, step=.05, mu=10, sigma=0.15, nu=-1, tau=c(4,10,20,40) )
# now using an gamlss object
# library(gamlss)
#data(abdom)
#h<-gamlss(y~cs(x,df=3), sigma.formula=~cs(x,1), family=BCT, data=abdom) # fits
#pdf.plot(obj=h , obs=c(23,67), min=50, max=150, step=.5)
```

plot.gamlss

Plot Residual Diagnostics for an GAMLSS Object

Description

This function provides four plots for checking the normalized (randomized for a discrete response distribution) quantile residuals of a fitted GAMLSS object, referred to as residuals below : a plot of residuals against fitted values, a plot of the residuals against an index or a specific explanatory variable, a density plot of the residuals and a normal Q-Q plot of the residuals. If argument `ts=TRUE` then the first two plots are replaced by the autocorrelation function (ACF) and partial autocorrelation function (PACF) of the residuals

Usage

```
## S3 method for class 'gamlss':
plot(x, xvar = NULL, parameters = NULL, ts = FALSE,
      summaries = TRUE, ...)
```

Arguments

<code>x</code>	a GAMLSS fitted object
<code>xvar</code>	an explanatory variable to plot the residuals against
<code>parameters</code>	plotting parameters can be specified here

<code>ts</code>	set this to TRUE if ACF and PACF plots of the residuals are required
<code>summaries</code>	set this to FALSE if no summary statistics of the residuals are required
<code>...</code>	further arguments passed to or from other methods.

Details

This function provides four plots for checking the normalized (randomized) quantile residuals (called `residuals`) of a fitted GAMLSS object. Randomization is only performed for discrete response variables. The four plots are

- residuals against the fitted values (or ACF of the residuals if `ts=TRUE`)
- residuals against an index or specified x-variable (or PACF of the residuals if `ts=TRUE`)
- kernel density estimate of the residuals
- QQ-normal plot of the residuals

For time series response variables option `ts=TRUE` can be used to plot the ACF and PACF functions of the residuals.

Value

Returns four plots related to the residuals of the fitted GAMLSS model and prints summary statistics for the residuals if the `summary=T`

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk) and Kalliope Akantziliotou

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#)

Examples

```
data(aids)
a<-gamlss(y~cs(x,df=7)+qrt,family=PO,data=aids)
plot(a)
rm(a)
```

`polyS`*Auxiliary support for the GAMLSS*

Description

These two functions are similar to the `poly` and `polym` in R. Are needed for the `gamlss.lo` function of GAMLSS and should not be used on their own.

Usage

```
polyS(x, ...)  
poly.matrix(m, degree = 1)
```

Arguments

<code>x</code>	a variable
<code>m</code>	a variable
<code>degree</code>	the degree of the polynomial
<code>...</code>	for extra arguments

Value

Returns a matrix of orthogonal polynomials

Warning

Not be use by the user

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk)

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [gamlss.lo](#)

predict.gamlss	<i>Extract Predictor Values and Standard Errors For New Data In a GAMLSS Model</i>
----------------	--

Description

predict.gamlss is the GAMLSS specific method which produce predictors for a new data set for a specified parameter from a GAMLSS objects. The predict.gamlss can be used to extract the linear predictors, fitted values and specific terms in the model at new data values in the same way that the predict.lm() and predict.glm() functions can be used for lm or glm objects. Note that linear predictors, fitted values and specific terms in the model at the current data values can also be extracted using the function lpred() (which is called from predict if new data is NULL).

Usage

```
## S3 method for class 'gamlss':
predict(object, what = c("mu", "sigma", "nu", "tau"),
        newdata = NULL, type = c("link", "response", "terms"),
        terms = NULL, se.fit = FALSE, data = NULL, ...)
predictAll(object, newdata = NULL, type = c("response", "link", "terms"),
           terms = NULL, se.fit = FALSE, ...)
```

Arguments

object	a GAMLSS fitted model
what	which distribution parameter is required, default what="mu"
newdata	a data frame containing new values for the explanatory variables used in the model
type	the default, gets the linear predictor for the specified distribution parameter. type="response" gets the fitted values for the parameter while type="terms" gets the fitted terms contribution
terms	if type="terms", which terms to be selected (default is all terms)
se.fit	if TRUE the approximate standard errors of the appropriate type are extracted if exist
data	the data frame used in the original fit if is not defined in the call
...	for extra arguments

Details

The predict function assumes that the object given in newdata is a data frame containing the right x-variables used in the model. This could possible cause problems if transformed variables are used in the fitting of the original model. For example, let us assume that a transformation of age is needed in the model i.e. `nage<-age^.5`. This could be fitted as `mod<-gamlss(y~cs(age^.5), data=mydata)` or as `nage<-age^.5; mod<-gamlss(y~cs(nage),`

`data=mydata`). The later could more efficient if the data are in thousands rather in hundreds. In the first case, the code `predict(mod, newdata=data.frame(age=c(34, 56)))` would produce the right results. In the second case a new data frame has to be created containing the old data plus any new transform data. This data frame has to be declared in the `data` option. The option `newdata` should contain a `data.frame` with the new names and the transformed values in which prediction is required, (see the last example).

Value

A vector or a matrix depending on the options.

Note

This function is under development

Author(s)

Mikis Stasinopoulos

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[lp](#), [lpred](#)

Examples

```
data(aids)
a<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
newaids<-data.frame(x=c(45,46,47), qrt=c(2,3,4))
ap <- predict(a, newdata=newaids, type = "response")
ap
# now getting all the parameters
predictAll(a, newdata=newaids)
rm(a, ap)
data(abdom)
# transform x
aa<-gamlss(y~cs(x^.5), data=abdom)
# predict at old values
predict(aa)[610]
# predict at new values
```

```

predict(aa,newdata=data.frame(x=42.43))
# now transform x first
nx<-abdom$x^.5
aaa<-gamlss(y~cs(nx),data=abdom)
# create a new data frame
newd<-data.frame(abdom, nx=abdom$x^0.5)
# predict at old values
predict(aaa)[610]
# predict at new values
predict(aaa,newdata=data.frame(nx=42.43^.5), data=newd)

```

```
print.gamlss          Prints a GAMLSS fitted model
```

Description

print.gamlss is the GAMLSS specific method for the generic function print which prints objects returned by modelling functions.

Usage

```
## S3 method for class 'gamlss':
print(x, digits = max(3, getOption("digits") - 3), ...)
```

Arguments

x	a GAMLSS fitted model
digits	the number of significant digits to use when printing
...	for extra arguments

Value

Prints a gamlss object

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk) and Calliope Akantziliotou

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files,(see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

`gamlss`, `deviance.gamlss`, `fitted.gamlss`

Examples

```
data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids)
print(h) # or just h
rm(h)
```

prof.dev

Plotting the Profile Deviance for one of the Parameters in a GAMLSS model

Description

This functions plots the profile deviance of one of the (four) parameters in a GAMLSS model. It can be used if one of the parameters `mu`, `sigma`, `nu` or `tau` is a constant (not a function of explanatory variables) to obtain a profile confidence intervals.

Usage

```
prof.dev(object, which = NULL, min = NULL, max = NULL, step = NULL,
         startlastfit = TRUE, type = "o", plot = TRUE, perc = 95,
         ...)
```

Arguments

<code>object</code>	A fitted GAMLSS model
<code>which</code>	which parameter to get the profile deviance e.g. <code>which="tau"</code>
<code>min</code>	the minimum value for the parameter e.g. <code>min=1</code>
<code>max</code>	the maximum value for the parameter e.g. <code>max=20</code>
<code>step</code>	how often to evaluate the global deviance (defines the step length of the grid for the parameter) e.g. <code>step=1</code>
<code>startlastfit</code>	whether to start fitting from the last fit or not, default value is <code>startlastfit=TRUE</code>
<code>type</code>	what type of plot required. This is the same as in <code>type</code> for <code>plot</code> , default value is <code>type="o"</code> , that is, both line and points
<code>plot</code>	whether to plot, <code>plot=TRUE</code> or save the results, <code>plot=FALSE</code>
<code>perc</code>	what % confidence interval is required
<code>...</code>	for extra arguments

Details

This function can be used to provide likelihood based confidence intervals for a parameter for which a constant model (i.e. no explanatory model) is fitted and consequently for checking the adequacy of a particular value of the parameter. This can be used to check the adequacy of one distribution (e.g. Box-Cox Cole and Green) nested within another (e.g. Box-Cox power exponential). For example one can test whether a Box-Cox Cole and Green (Box-Cox-normal) distribution or a Box-Cox power exponential is appropriate by plotting the profile of the parameter τ . A profile deviance showing support for $\tau=2$ indicates adequacy of the Box-Cox Cole and Green (i.e. Box-Cox normal) distribution.

Value

A plot of profile global deviance

Warning

A dense grid (i.e. small step) evaluation of the global deviance can take a long time, so start with a sparse grid (i.e. large step) and decrease gradually the step length for more accuracy.

Author(s)

Calliope Akantziliotou, Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk> and Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape, (with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [prof.term](#)

Examples

```
data(abdom)
h<-gamlss(y~cs(x,df=3), sigma.formula=~cs(x,1), family=BCT, data=abdom)
prof.dev(h, "nu", min=-2.000, max=2, step=0.25, type="l")
rm(h)
```

 prof.term

Plotting the Profile: deviance or information criterion for one of the terms (or hyper-parameters) in a GAMLSS model

Description

This functions plots the profile deviance for a chosen parameter included in the linear predictor of any of the mu, sigma, nu or tau models so profile confidence intervals can be obtained. In can also be used to plot the profile of a specified information criterion for any hyperparameter.

Usage

```
prof.term(model = NULL, criterion = "GD", penalty = 2.5, other = NULL,
          min = NULL, max = NULL, step = NULL, type = "o", xlabel = NULL,
          plot = TRUE, term = TRUE, perc = 95, ... )
```

Arguments

model	this is a GAMLSS model, e.g. model=gamlss(y~cs(x, df=this), sigma.fo=~cs(x, df=3), data=abdom), where this indicates the (hyper)parameter to be profiled
criterion	whether global deviance ("GD") or information criterion ("IC") is profiled. The default is criterion="GD"
penalty	The penalty value if information criterion is used in criterion, default penalty=2.5
other	this can be used to evaluate an expression before the actual fitting of the model
min	the minimum value for the parameter e.g. min=1
max	the maximum value for the parameter e.g. max=20
step	how often to evaluate the global deviance (defines the step length of the grid for the parameter) e.g. step=1
type	what type of plot required. This is the same as in type for plot, default value is type="o", that is, both line and points
xlabel	if a label for the axis is required
plot	whether to plot, plot=TRUE or save the results, plot=FALSE
term	this has the value TRUE and it should be changed to FALSE if a profile global deviance is required for a hyperparameter so the IC are suppressed
perc	what % confidence interval is required
...	for extra arguments

Details

This function can be use to provide likelihood based confidence intervals for a parameter involved in terms in the linear predictor(s). These confidence intervals are more accurate than the ones obtained from the parameters' standard errors. The function can also be used to plot a profile information criterion (with a given penalty) against a hyperparameter. This can be used to check the uniqueness in hyperparameter determination using for example find.df.

Value

Return a profile plot (if the argument `plot=TRUE`) or the values of the parameters and the IC or GD values otherwise

Warning

A dense grid (i.e. small step) evaluation of the global deviance can take a long time, so start with a sparse grid (i.e. large step) and decrease gradually the step length for more accuracy.

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk> and Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [prof.dev](#)

Examples

```
data(aids)
gamlss(y~x+qrt, family=NBI, data=aids)
mod<-quote(gamlss(y ~ offset(this * x) + qrt, data = aids, family = NBI))
prof.term(mod, min=0.06, max=0.11, step=0.001)
mod1<-quote(gamlss(y ~ cs(x,df=this) + qrt, data = aids, family = NBI))
prof.term(mod1, min=1, max=15, step=1, criterion="IC")
mod2 <- quote(gamlss(y ~ x+I((x>this)*(x-this))+qrt, family=NBI, data=aids))
prof.term(mod2, min=1, max=45, step=1, criterion="GD")
rm(mod, mod1, mod2)
```

Description

There are several function operating penalised B-splines: `pb()`, `cy()`, and `ps()`. The functions take a vector and return it with several attributes. The vector is used in the construction of the design matrix X used in the fitting. The functions do not do the smoothing, but assign the attributes to the vector to aid `gamlss` in the smoothing. The functions doing the smoothing are `gamlss.ps()`, `gamlss.pb()` and `gamlss.cy()` which are used in the backfitting function `additive.fit`. The function `pb()` is more efficient and faster than the original penalized smoothing function `ps()`. `pb()` allows the estimation of the smoothing parameters using different local (performance iterations) methods. The method are "ML", "ML-1", "EM", "GAIC" and "GCV". The function `cy()` fits a cycle penalised beta regression spline such as the last fitted value of the smoother is equal to the first fitted value.

Usage

```
pb(x, df = NULL, lambda = NULL, control = pb.control(...), ...)
pb.control(inter = 20, degree = 3, order = 2, start = 10, quantiles = FALSE,
           method = c("ML", "GAIC", "GCV", "EM", "ML-1"), k = 2, ...)
cy(x, df = NULL, lambda = NULL, control = cy.control(...), ...)
cy.control(inter = 20, degree = 3, order = 2, start = 10,
           method = c("ML", "GAIC", "GCV", "EM", "ML-1"), k = 2, ts=FALSE, ...)
ps(x, df = 3, lambda = NULL, ps.intervals = 20, degree = 3, order = 3)
```

Arguments

<code>x</code>	the univariate predictor
<code>df</code>	the desired equivalent number of degrees of freedom (trace of the smoother matrix minus two for the constant and linear fit)
<code>lambda</code>	the smoothing parameter
<code>control</code>	setting the control parameters
<code>...</code>	for extra arguments
<code>inter</code>	the no of break points (knots) in the x-axis
<code>degree</code>	the degree of the piecewise polynomial
<code>order</code>	the required difference in the vector of coefficients
<code>start</code>	the lambda starting value if the local methods are used, see below
<code>quantiles</code>	if TRUE the quantile values of x are use to determine the knots
<code>ts</code>	if TRUE assumes that it is a seasonal factor
<code>method</code>	The method used in the (local) performance iterations. Available methods are "ML", "ML-1", "EM", "GAIC" and "GCV"
<code>k</code>	the penalty used in "GAIC" and "GCV"
<code>ps.intervals</code>	the no of break points in the x-axis

Details

The `ps()` function is based on Brian Marx function which can be found in <http://www.stat.lsu.edu/faculty/marx/>. The `pb()` and `cy()` functions are based on Paul Eilers original R functions. Note that `ps()` and `pb()` functions behave differently at their default values if `df` and `lambda` are not specified. `ps(x)` by default will use 3 extra degrees of freedom for smoothing `x`. `pb(x)` by default will estimate `lambda` (and the degrees of freedom) automatically using a local method. Local (or performance iterations) methods available are (i) Maximum Likelihood, "ML", (ii) Generalized Akaike information criterion, "GAIC" (iii) Generalized Cross validation. (iv) EM-algorithm, "EM" (very slow) and (v) a modified version of the ML, "ML-1" which produce identical results with "EM" but faster. Note that if the local (or performance iterations) methods can be make the convergence of `gamlss` less stable compared to a model where the degrees of freedom are fixed.

Value

the vector `x` is returned, endowed with a number of attributes. The vector itself is used in the construction of the model matrix, while the attributes are needed for the backfitting algorithms `additive.fit()`.

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk) and Paul Eilers

References

<http://www.stat.lsu.edu/faculty/marx/>

Eilers, P. H. C. and Marx, B. D. (1996). Flexible smoothing with B-splines and penalties (with comments and rejoinder). *Statist. Sci*, **11**, 89-121.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [gamlss.ps](#), [cs](#)

Examples

```
data(aids)
# fitting a smoothing cubic spline with 7 degrees of freedom
# plus the a quarterly effect
aids1<-gamlss(y~ps(x,df=7)+qrt,data=aids,family=PO) #
aids2<-gamlss(y~pb(x,df=7)+qrt,data=aids,family=PO) #
aids3<-gamlss(y~pb(x)+qrt,data=aids,family=PO) #
with(aids, plot(x,y))
with(aids, lines(x,fitted(aids1),col="red"))
with(aids, lines(x,fitted(aids2),col="green"))
```

```

with(aids, lines(x, fitted(aids1), col="yellow"))
rm(aids1, aids2, aids3)
# simulate data
set.seed(555)
x = seq(0, 1, length = 100)
y = sign(cos(1 * x * 2 * pi + pi / 4)) + rnorm(length(x)) * 0.2
plot(y~x)
m1<-gamlss(y~cy(x))
lines(fitted(m1)~x)
rm(y, x, m1)

```

Q.stats

A function to calculate the Q-statistics

Description

This function calculates and prints the Q-statistics which are useful to test normality of the residuals within a range of an independent variable, for example age in centile estimation, see Royston and Wright (2000).

Usage

```

Q.stats(obj, xvar = NULL, xcut.points = NULL, n.inter = 10, zvals = TRUE,
        save = TRUE, ...)

```

Arguments

obj	a GAMLSS object or any other residual vector
xvar	a unique explanatory variable
xcut.points	the x-axis cut off points e.g. c(20, 30). If xcut.points=NULL then the n.inter argument is activated
n.inter	if xcut.points=NULL this argument gives the number of intervals in which the x-variable will be split, with default 4
zvals	if TRUE the output matrix contains the individual z's rather than Q statistics
save	whether to save the Q-statistics or not with default equal to TRUE. In this case the functions produce a matrix giving individual Q (or z) statistics and the final aggregate Q's
...	for extra arguments

Value

A matrix containing the individual Q's and the aggregate Q-statistics

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk), with contributions from Elaine Borghie

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Royston P. and Wright E. M. (2000) Goodness of fit statistics for the age-specific reference intervals. *Statistics in Medicine*, 19, pp 2943-2962.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [centiles.split](#), [wp](#)

Examples

```
data(abdom)
h<-gamlss(y~cs(x,df=3), sigma.formula=~cs(x,1), family=BCT, data=abdom)
Q.stats(h,xvar=abdom$x,n.inter=8)
Q.stats(h,xvar=abdom$x,n.inter=8,zvals=FALSE)
rm(h)
```

 ra

Specify Simple Random Effect In A GAMLSS Formula

Description

This is an experimental smoother for use with factors in `gamlss()`. It allows the fitted values for a factor predictor to be shrunk towards the overall mean, where the amount of shrinking depends either on `lambda`, or on the equivalent degrees of freedom (`df`).

This function is slightly more general, but considerably slower than the `random` function .

Usage

```
ra(xfactor, xvector = NULL, df = NULL, lambda = NULL, order = 0,
  estimate = FALSE, expl = NULL, data1 = NULL)
```

Arguments

<code>xfactor</code>	a factor defining the subjects grouping in a one factor random effect model term e.g. <code>xfactor=Subjects</code>
<code>xvector</code>	a variable if interaction with the <code>xfactor</code> is required <code>xvector</code> (experimental)
<code>df</code>	required equivalent degrees of freedom e.g. <code>df=10</code>

lambda	the smoothing parameter which is the reciprocal (i.e. inverse) of the variance of the random effect
order	the order of the difference in the matrix D, <code>order=1</code> is for simple random effects, <code>order=2</code> is for random walk order 1 and <code>order=3</code> is for random walk order 2
estimate	whether to estimate the lambda parameter within the backfitting iterations (very unreliable). Set by default to <code>estimate=FALSE</code> . [The lambda parameter can be more accurately estimated by selecting the corresponding smoothing degrees of freedom using find.hyper]
expl	this allows an explanatory variable at the subject level to be fitted e.g. <code>expl=~x1+x2</code>
data1	the data frame for the subject level variables <code>data1</code>

Value

`xfactor` is returned with class "smooth", with an attribute named "call" which is to be evaluated in the backfitting `additive.fit()` called by `gamlss()`

Warning

This is experimental and likely to change soon

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[random](#), [gamlss](#)

Examples

```
data(aids)
attach(aids)
# fitting a loess curve with span=0.4 plus the a quarterly effect
aids1<-gamlss(y~lo(x,span=0.4)+qrt,data=aids,family=PO) #
# now we string the quarterly effect using random
aids2<-gamlss(y~lo(x,span=0.4)+ra(qrt,df=2),data=aids,family=PO) #
```

```
plot(x,y)
lines(x,fitted(aids1),col="red")
lines(x,fitted(aids2),col="purple")
rm(aids1,aids2)
detach(aids)
```

random

Specify a simple random effect in a GAMLSS Formula

Description

Includes random effect terms in an GAMLSS model.

Usage

```
random(xvar, df = NULL, lambda = 0)
```

Arguments

xvar	a factor
df	the target degrees of freedom
lambda	the smoothing parameter lambda which can be viewed as a shrinkage parameter.

Details

This is an experimental smoother for use with factors in `gamlss()`. It allows the fitted values for a factor predictor to be shrunk towards the overall mean, where the amount of shrinking depends either on lambda, or on the equivalent degrees of freedom. Similar in spirit to smoothing splines, this fitting method can be justified on Bayesian grounds or by a random effects model.

Since factors are coded by `model.matrix()` into a set of contrasts, care has been taken to add an appropriate "contrast" attribute to the output of `random()`. This zero contrast results in a column of zeros in the model matrix, which is aliased with any column and is hence ignored

Value

x is returned with class "smooth", with an attribute named "call" which is to be evaluated in the backfitting `additive.fit()` called by `gamlss()`

Author(s)

Trevor Hastie (amended by Mikis Stasinopoulos)

References

Chambers, J. M. and Hastie, T. J. (1991). *Statistical Models in S*, Chapman and Hall, London.

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [gamlss.random](#)

Examples

```
data(aids)
attach(aids)
# fitting a loess curve with span=0.4 plus the a quarterly effect
aids1<-gamlss(y~lo(x,span=0.4)+qrt,data=aids,family=PO) #
# now we string the quarterly effect using random
aids2<-gamlss(y~lo(x,span=0.4)+random(qrt,df=2),data=aids,family=PO) #
plot(x,y)
lines(x,fitted(aids1),col="red")
lines(x,fitted(aids2),col="purple")
rm(aids1,aids2)
detach(aids)
```

 rc

Specify Random Coefficients In A GAMLSS Formula

Description

Fits Random Coefficients In A GAMLSS Model.

Usage

```
rc(formula, lambda = NULL)
```

Arguments

formula	a model formula to specify the explanatory variable and the subject grouping factor e.g. formula=~x1 Subjects will fit random constant and slopes for x1 for each level of Subjects
lambda	a matrix specifying the variance-covariance matrix for the random coefficients e.g. lambda=diag{2,5}

Details

This is an experimental function and it is likely to change in the near future. For a chosen fixed variance-covariance matrix for the random coefficients, this function finds the MAP estimates for the constant and slope random effects for the different subjects

Value

The variables in the left side of the formula are returned with class "smooth", and attribute named "call" which is to be evaluated in the backfitting `additive.fit()` called by `gamlss()`

Warning

This is experimental

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>)

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[random](#), [ra](#), [gamlss](#)

refit

Refit a GAMLSS model

Description

This function refits a GAMLSS model. It is useful when the algorithm has not converged after 20 outer iteration (the default value)

Usage

```
refit(object, ...)
```

Arguments

`object` a GAMLSS fitted model which has not converged
`...` for extra arguments

Details

This function is useful when the iterations have reach the maximum value set by the code(`n.cyc`) of the `gamlss.control` function and the model has not converged yet

Value

Returns a GAMLSS fitted model

Note

The function `update` does a very similar job

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

`gamlss`, `update.gamlss`

Examples

```
data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
refit(h)
rm(h)
```

```
residuals.gamlss Extract Residuals from GAMLSS model
```

Description

`residuals.gamlss` is the GAMLSS specific method for the generic function `residuals` which extracts the residuals for a fitted model. The abbreviated form `resid` is an alias for `residuals`.

Usage

```
## S3 method for class 'gamlss':
residuals(object, what = c("z-scores", "mu", "sigma", "nu", "tau"),
          type = c("simple", "weighted", "partial"),
          terms=NULL, ...)
```

Arguments

<code>object</code>	a GAMLSS fitted model
<code>what</code>	specify whether the standardized residuals are required, called here the "z-scores", or residuals for a specific parameter
<code>type</code>	the type of residual if residuals for a parameter are required
<code>terms</code>	if type is "partial" this specifies which term is required
<code>...</code>	for extra arguments

Details

The "z-scores" residuals saved in a GAMLSS object are the normalized (randomized) quantile residuals (see Dunn and Smyth, 1996). Randomization is only needed for the discrete family distributions, see also [rqres.plot](#). Residuals for a specific parameter can be "simple" = (working variable - linear predictor), "weighted" = $\sqrt{\text{working weights}} \times (\text{working variable} - \text{linear predictor})$ or "partial" = (working variable - linear predictor) + contribution of specific terms.

Value

a vector or a matrix of the appropriate residuals of a GAMLSS model. Note that when weights are used in the fitting the length of the residuals can be different from N the length of the fitted values. Observations with weights equal to zero are not appearing in the residuals. Also observations with frequencies as weights will appear more than once according to their frequencies.

Note

The "weighted" residuals of a specified parameter can be zero and one if the square of first derivative have been used in the fitting of this parameter

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk)

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[print.gamlss](#), [summary.gamlss](#), [fitted.gamlss](#), [coef.gamlss](#), [residuals.gamlss](#), [update.gamlss](#), [plot.gamlss](#), [deviance.gamlss](#), [formula.gamlss](#)

Examples

```
data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=NBI, data=aids) #
plot(aids$x, resid(h))
plot(aids$x, resid(h, "sigma" ) )
rm(h)
```

ridge

Specify Ridge regression In A GAMLSS Formula

Description

The function `ri()` allow the user to fit a ridge regression within GAMLSS. It allows the coefficients of a set of explanatory variables to be shrunk towards an overall zero, where the amount of shrinking depends either on lambda, or on the equivalent degrees of freedom (df). The function `ri()` can estimate lambda a local REML-algorithm.

Usage

```
ridge(X, df = NULL, lambda = NULL, order = 0)
ri(X, df = NULL, lambda = NULL, order = 0, start = 10)
```

Arguments

X	A standardized (mean=0, sd=1) matrix X of explanatory variables
df	the effective degrees of freedom df
lambda	the smoothing parameter lambda
order	the order of the difference applied to the coefficients
start	the lambda starting value if the Schall's EM-algorithm is used

Value

`x` is returned with class "smooth", with an attribute named "call" which is to be evaluated in the backfitting `additive.fit()` called by `gamlss()`

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk) and Paul Eilers

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[ra](#), [gamlss](#)

Examples

```
data(usair)
# standarized the x's
for (i in 2:7) usair[,i] <- (usair[,i]-mean(usair[,i]))/sd(usair[,i])
# create a matrix
usair$X <-as.matrix(usair[,c("x1","x2", "x3","x4", "x5", "x6")])
m1<- gamlss(y~ridge(X, df=3), data=usair, family=GA)
m2<- gamlss(y~ridge(X, lambda=10), data=usair, family=GA)
# plotting the coeficients as function of the df
df <- seq(0,6,0.5)
resmat<-matrix(0, nrow=length(df), ncol=6)
for (i in 1:length(df))
{
  resmat[i,] <- gamlss(y~ridge(X, df=df[i]), data=usair)$mu.coefSmo[[1]][["coef"]]
}
colnames(resmat)<-colnames(usair$X)
plot(1:length(df), type="n", xlim=c(-.5,6.5), ylim=c(-23, 38))
for (i in 1:6)
{
  lines(resmat[,i]~df, col="purple")
  points(resmat[,i]~df)
}
lines(rep(0,length(df))~df, col="black")
# now estimating the lambda
g1<-gamlss(y~ri(X), data=usair)
```

```
m1$mu.coefSmo
```

```
rqres.plot
```

Plotting Randomized Quantile Residuals

Description

This function plots QQ-plots of the normalized randomized quantile residuals (see Dunn and Smyth, 1996) for a model using a discrete GAMLSS family distribution.

Usage

```
rqres.plot(obj = NULL, howmany = 6, all = TRUE, save = FALSE, ...)
```

Arguments

<code>obj</code>	a fitted GAMLSS model object from a "discrete" type of family
<code>howmany</code>	The number of QQ-plots required up to ten i.e. <code>howmany=6</code>
<code>all</code>	if TRUE QQ-plots from <code>howmany</code> realizations are plotted. If FALSE then a single qq-plot of the median of the <code>howmany</code> realizations is plotted
<code>save</code>	If TRUE the median residuals can be saved
<code>...</code>	for extra arguments

Details

For discrete family distributions, the `gamlss()` function saves on exit one realization of randomized quantile residuals which can be plotted using the generic function `plot` which calls the `plot.gamlss`. Looking at only one realization can be misleading, so the current function creates QQ-plots for several realizations. The function allows up to 10 QQ-plots to be plotted. Occasionally one wishes to create a lot of realizations and then take a median of them (separately for each ordered value) to create a single median realization. The option `all` in combinations with the option `howmany` creates a QQ-plot of the medians of the normalized randomized quantile residuals. These 'median' randomized quantile residuals can be saved using the option (`save=TRUE`).

Value

If `save` it is TRUE then the vector of the median residuals is saved.

Warning

....

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>

References

- Dunn, P. K. and Smyth, G. K. (1996) Randomised quantile residuals, *J. Comput. Graph. Statist.*, **5**, 236–244
- Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.
- Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).
- Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[plot.gamlss](#), [gamlss](#)

Examples

```
data(aids) # fitting a model from a discrete distribution
h<-gamlss(y~cs(x,df=7)+qrt, family=NBI, data=aids) #
plot(h)
# plot qq- plots from 6 realization of the randomized quantile residuals
rqres.plot(h)
# a qq-plot from the medians from 40 realizations
rqres.plot(h,howmany=40,all=FALSE) #
```

stepGAIC

Choose a model by GAIC in a Stepwise Algorithm

Description

The function `stepGAIC()` performs stepwise model selection using a Generalized Akaike Information Criterion. The function `stepGAIC()` calls one of the two functions `stepGAIC.VR()` or `stepGAIC.CH()` depending on the argument `additive`. The function `stepGAIC.VR()` is based on the function `stepAIC()` given in the library MASS of Venables and Ripley (2002). The function `stepGAIC.CH` is based on the S function `step.gam()` (see Chambers and Hastie (1991)) and it is more suited for model with smoothing additive terms. Both functions have been adapted to work with `gamlss` objects. The main difference for the user is the `scope` argument, see below. If the `stepGAIC()` is called with the argument `additive=FALSE` then the `stepGAIC.VR()` is called else the `stepGAIC.CH()`.

Usage

```
stepGAIC.VR(object, scope, direction = c("both", "backward", "forward"),
            trace = T, keep = NULL, steps = 1000, scale = 0,
```

```

what = c("mu", "sigma", "nu", "tau"), k = 2, ...)

stepGAIC.CH(object, scope = gamlss.scope(model.frame(object)),
             direction = c("both", "backward", "forward"), trace = T, keep = NULL,
             steps = 1000, what = c("mu", "sigma", "nu", "tau"), k = 2, ...)

stepGAIC(object, scope = gamlss.scope(model.frame(object)),
          direction = c("both", "backward", "forward"),
          trace = T, keep = NULL, steps = 1000,
          what = c("mu", "sigma", "nu", "tau"), k = 2,
          additive = FALSE, ...)

```

Arguments

object	an <code>gamlss</code> object. This is used as the initial model in the stepwise search.
scope	defines the range of models examined in the stepwise search. For the function <code>stepAIC()</code> this should be either a single formula, or a list containing components <code>upper</code> and <code>lower</code> , both formulae. See the details for how to specify the formulae and how they are used. For the function <code>stepGAIC</code> the scope defines the range of models examined in the step-wise search. It is a list of formulas, with each formula corresponding to a term in the model. A 1 in the formula allows the additional option of leaving the term out of the model entirely. +
direction	the mode of stepwise search, can be one of <code>both</code> , <code>backward</code> , or <code>forward</code> , with a default of <code>both</code> . If the <code>scope</code> argument is missing the default for <code>direction</code> is <code>backward</code>
trace	if positive, information is printed during the running of <code>stepAIC</code> . Larger values may give more information on the fitting process.
keep	a filter function whose input is a fitted model object and the associated 'AIC' statistic, and whose output is arbitrary. Typically 'keep' will select a subset of the components of the object and return them. The default is not to keep anything.
steps	the maximum number of steps to be considered. The default is 1000 (essentially as many as required). It is typically used to stop the process early.
scale	scale is nor used in <code>gamlss</code>
what	which distribution parameter is required, default <code>what="mu"</code>
k	the multiple of the number of degrees of freedom used for the penalty. Only 'k = 2' gives the genuine AIC: 'k = log(n)' is sometimes referred to as BIC or SBC.
additive	if <code>additive=TRUE</code> then <code>stepGAIC.CH</code> is used else <code>stepGAIC</code> .CH, default value is <code>FALSE</code>
...	any additional arguments to 'extractAIC'. (None are currently used.)

Details

The set of models searched is determined by the `scope` argument.

For the function `stepGAIC.VR()` the right-hand-side of its `lower` component is always included in the model, and right-hand-side of the model is included in the `upper` component. If `scope` is a single formula, it specifies the `upper` component, and the `lower` model is empty. If `scope` is missing, the initial model is used as the `upper` model.

Models specified by `scope` can be templates to update `object` as used by `update.formula`.

For the function `stepGAIC.CH()` each of the formulas in `scope` specifies a "regimen" of candidate forms in which the particular term may enter the model. For example, a term formula might be

```
~ x1 + log(x1) + cs(x1, df=3)
```

This means that `x1` could either appear linearly, linearly in its logarithm, or as a smooth function estimated non-parametrically. Every term in the model is described by such a term formula, and the final model is built up by selecting a component from each formula.

The function `gamlss.scope` similar to the S `gam.scope()` in Chambers and Hastie (1991) can be used to create automatically term formulae from specified data or model frames.

The supplied model object is used as the starting model, and hence there is the requirement that one term from each of the term formulas of the parameters be present in the formula of the distribution parameter. This also implies that any terms in formula of the distribution parameter not contained in any of the term formulas will be forced to be present in every model considered.

Value

the stepwise-selected model is returned, with up to two additional components. There is an "anova" component corresponding to the steps taken in the search, as well as a "keep" component if the 'keep=' argument was supplied in the call. The "Resid. Dev" column of the analysis of deviance table refers to a constant minus twice the maximized log likelihood

Author(s)

Mikis Stasinopoulos based on functions in MASS library and in Statistical Models in S

References

- Chambers, J. M. and Hastie, T. J. (1991). *Statistical Models in S*, Chapman and Hall, London.
- Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.
- Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).
- Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.
- Venables, W. N. and Ripley, B. D. (2002) *Modern Applied Statistics with S*. Fourth edition. Springer.

See Also

[gamlss.scope](#)

Examples

```

data(usair)
# Note default of additive=FALSE
# fitting all variables linearly
mod1<-gamlss(y~., data=usair, family=GA)
# find the best subset for the mu
mod2<-stepGAIC(mod1)
mod2$anova
# find the best subset for sigma
mod3<-stepGAIC(mod2, what="sigma", scope=~x1+x2+x3+x4+x5+x6)
mod3$anova
# now use the stepGAIC.CH function
# creating a scope from the usair model frame
gs<-gamlss.scope(model.frame(y~x1+x2+x3+x4+x5+x6, data=usair))
gs
mod4<-gamlss(y~1, data=usair, family=GA)
mod5<-stepGAIC(mod4,gs, additive=TRUE)
mod5$anova
mod6<-stepGAIC(mod5, what="sigma", scope=~x1+x2+x3+x4+x5+x6)
mod6$anova
mod6

```

summary.gamlss

Summarizes a GAMLSS fitted model

Description

summary.gamlss is the GAMLSS specific method for the generic function summary which summarize objects returned by modelling functions.

Usage

```

## S3 method for class 'gamlss':
summary(object, type = c("vcov", "qr"), ...)

```

Arguments

object	a GAMLSS fitted model
type	the default value vcov uses the vcov() method for gamlss to get the variance-covariance matrix of the estimated beta coefficients, see details below. The alternative qr is the original method used in gamlss to estimated the standard errors but it is not reliable since it do not take into the account the inter-correlation between the distributional parameters mu, sigma, nu and tau.
...	for extra arguments

Details

Using the default value `type="vcov"`, the `vcov()` method for `gamlss` is used to get the variance covariance matrix (and consequently the standard errors) of the beta parameters. The variance covariance matrix is calculated using the inverse of the numerical second derivatives of the observed information matrix. This is a more reliable method since it takes into account the inter-correlation between all the parameters. The `type="qr"` assumes that the parameters are fixed at the estimated values. Note that both methods are not appropriate and should be used with caution if smoothing terms are used in the fitting.

Value

Print summary of a GAMLSS object

Author(s)

Mikis Stasinopoulos (d.stasinopoulos@londonmet.ac.uk), Bob Rigby (r.rigby@londonmet.ac.uk) and Calliope Akantziliotou

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape, (with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2003) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss](#), [deviance.gamlss](#), [fitted.gamlss](#)

Examples

```
data(aids)
h<-gamlss(y~poly(x,3)+qrt, family=PO, data=aids) #
summary(h)
rm(h)
```

term.plot

*Plot regression terms for a specified parameter of a GAMLSS object***Description**

Plots regression terms against their predictors, optionally with standard errors and partial residuals added. It is almost identical to the R function `termplot` suitable changed to apply to GAMLSS objects.

Usage

```
term.plot(object, what = c("mu", "sigma", "nu", "tau"), data = NULL,
          envir = environment(formula(object)),
          partial.resid = FALSE, rug = FALSE,
          terms = NULL, se = FALSE, xlabs = NULL, ylabs = NULL,
          main = NULL, col.term = 2, lwd.term = 1.5,
          col.se = "orange", lty.se = 2, lwd.se = 1,
          col.res = "gray", cex = 1, pch = par("pch"),
          col.smth = "darkred", lty.smth = 2,
          span.smth = 2/3,
          ask = interactive() && nb.fig < n.tms && .Device != "postscript",
          use.factor.levels = TRUE, smooth = NULL, ...)
```

Arguments

<code>object</code>	a GAMLSS object
<code>what</code>	the required parameter of the GAMLSS distribution
<code>data</code>	data frame in which variables in <code>object</code> can be found
<code>envir</code>	environment in which variables in <code>object</code> can be found
<code>partial.resid</code>	logical; should partial residuals be plotted?
<code>rug</code>	add rugplots (jittered 1-d histograms) to the axes?
<code>terms</code>	which terms to plot (default 'NULL' means all terms)
<code>se</code>	plot pointwise standard errors?
<code>xlabs</code>	vector of labels for the x axes
<code>ylabs</code>	vector of labels for the y axes
<code>main</code>	logical, or vector of main titles; if 'TRUE', the model's call is taken as main title, 'NULL' or 'FALSE' mean no titles.
<code>col.term, lwd.term</code>	color and width for the "term curve", see 'lines'.
<code>col.se, lty.se, lwd.se</code>	color, line type and line width for the "twice-standard-error curve" when 'se = TRUE'.

col.res, cex, pch
 color, plotting character expansion and type for partial residuals, when 'partial.resid = TRUE', see 'points'.

lty.smth, col.smth, span.smth
 Passed to 'smooth'

ask
 logical; if 'TRUE', the user is asked before each plot, see 'par(ask=.)'.

use.factor.levels
 Should x-axis ticks use factor levels or numbers for factor terms?

smooth
 'NULL' or a function with the same arguments as 'panel.smooth' to draw a smooth through the partial residuals for non-factor terms

...
 other graphical parameters

Details

The function uses the `lpred` function of GAMLSS. The 'data' argument should rarely be needed, but in some cases 'termplot' may be unable to reconstruct the original data frame. Using 'na.action=na.exclude' makes these problems less likely. Nothing sensible happens for interaction terms.

Value

a plot of fitted terms.

Author(s)

Mikis Stasinopoulos based on the existing `termplot()` function

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[termplot](#)

Examples

```
data(aids)
a<-gamlss(y~cs(x,df=8)+qrt,data=aids,family=NBI)
term.plot(a, se=TRUE)
rm(a)
```

update.gamlss *Update and Re-fit a GAMLSS Model*

Description

update.gamlss is the GAMLSS specific method for the generic function update which updates and (by default) refits a GAMLSS model.

Usage

```
## S3 method for class 'gamlss':
update(object, formula., ..., what = c("mu", "sigma", "nu", "tau"),
       evaluate = TRUE)
```

Arguments

object	a GAMLSS fitted model
formula.	the formula to update
...	for updating argument in <code>gamlss()</code>
what	the parameter in which the formula needs updating
evaluate	whether to evaluate the call or not

Value

Returns a GAMLSS object

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk>, Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[print.gamlss](#), [summary.gamlss](#), [fitted.gamlss](#), [coef.gamlss](#), [residuals.gamlss](#), [plot.gamlss](#), [deviance.gamlss](#), [formula.gamlss](#)

Examples

```

data(aids)
# fit a poisson model
h.po <-gamlss(y~cs(x,2)+qrt, family=PO, data=aids)
# update with a negative binomial
h.nb <-update(h.po, family=NBI)
# update the smoothing
h.nb1 <-update(h.nb,~cs(x,8)+qrt)
# remove qrt
h.nb2 <-update(h.nb1,~.-qrt)
# put back qrt take log of y and fit a normal distribution
h.nb3 <-update(h.nb1,log(.)~.+qrt, family=NO)
# verify that it is the same
h.no<-gamlss(log(y)~cs(x,8)+qrt,data=aids )

```

VGD

Validation (or test) data global deviance

Description

These function are useful for model selection. The function VGD helps to validate a GAMLSS model by randomly splitting the data into training and validation sets. It minimizes the global deviance for the training data set and then uses the validation set to calculate the prediction global deviance. The function VGD1 is identical to VGD but the output is a list rather than a values as in VGD. The function VGD2 is identical to VGD1 but it takes as argument the new data, (*newdata*), rather than a factor which split the combined data in two as in VGD or VGD1. The function TGD takes a fitted *gamlss* object and produce the test global deviance for the new data. The resulting prediction errors can be used for selecting the distribution of the model, the terms in the model or degrees of freedom for smoothing terms.

Usage

```

VGD(formula = NULL, sigma.fo = ~1, nu.fo = ~1, tau.fo = ~1,
     data = NULL, family = NO,
     control = gamlss.control(trace = FALSE), rand = NULL, ...)
VGD1(formula = NULL, sigma.fo = ~1, nu.fo = ~1, tau.fo = ~1,
      data = NULL, family = NO,
      control = gamlss.control(trace = FALSE), rand = NULL, ...)
VGD2(formula = NULL, sigma.fo = ~1, nu.fo = ~1, tau.fo = ~1,
      data = NULL, family = NO,
      control = gamlss.control(trace = FALSE),
      newdata = NULL, ...)
TGD(object, newdata = NULL, ...)

```

Arguments

object a *gamlss* object

<code>formula</code>	a <code>gamlss</code> formula for μ (including the response on the left)
<code>sigma.fo</code>	a formula for σ
<code>nu.fo</code>	a formula for ν
<code>tau.fo</code>	a formula for τ
<code>data</code>	the data set used for the fitting
<code>newdata</code>	the data set to be used for validation or test
<code>family</code>	a <code>gamlss.family</code> object
<code>control</code>	<code>gamlss.control</code> to be passed to <code>gamlss</code>
<code>rand</code>	a random vector of one and two indicating whether is the training set (1) or the validation set (2) i.e. created in advance using something like <code>rand <- sample(2, N, replace=T, prob=c(0.6, 0.4))</code> where N is the length of the data
<code>...</code>	for extra arguments to be passed in the <code>gamlss</code> fit

Value

The function `VGD` returns a validated global deviance, that is, the global deviance evaluated at the validation data. The functions `VGD1`, `VGD2` and `TGD` are returning a list with component `oldGD`, `newGD`, `oldPE`, `newPE`. `oldGD` is the deviance of the training data, `newGD` is the deviance for the validation or (test) data. `oldPE` is the mean prediction error for the old data (`oldGD` divided by the number of observations in the training data). `newPE` is the mean prediction error for the new data, (`newGD` divided by the number of observations in the validation (or test) data).

Author(s)

Mikis Stasinopoulos <d.stasinopoulos@londonmet.ac.uk> and Bob Rigby <r.rigby@londonmet.ac.uk>

References

Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape, (with discussion), *Appl. Statist.*, **54**, part 3, pp 507-554.

Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).

Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.

See Also

[gamlss.family](#), [gamlss](#), [deviance.gamlss](#)

Examples

```

data(abdom)
# generate the random split of the data
rand <- sample(2, 610, replace=TRUE, prob=c(0.6,0.4))
# the proportions in the sample
table(rand)/610
VGD(y~cs(x,df=2),sigma.fo~cs(x,df=1), data=abdom, family=LO, rand=rand)
VGD1(y~cs(x,df=2),sigma.fo~cs(x,df=1), data=abdom, family=LO, rand=rand)
VGD2(y~cs(x,df=2),sigma.fo~cs(x,df=1), data=abdom[rand==1,], family=LO,
      newdata=abdom[rand==2,] )

```

wp

Worm plot

Description

Provides single or multiple worm plots for GAMLSS fitted objects. This is a diagnostic tool for checking the residuals within different ranges (by default not overlapping) of the explanatory variable

Usage

```

wp(object, xvar = NULL, n.inter = 4, xcut.points = NULL,
    overlap = 0, xlim.all = 4, xlim.worm = 3.5,
    show.given = TRUE, line = TRUE,
    ylim.all = 12 * sqrt(1/length(fitted(object))),
    ylim.worm = 12 * sqrt(n.inter/length(fitted(object))),
    cex = 1, pch = 21, ...)

```

Arguments

<code>object</code>	a GAMLSS fitted object
<code>xvar</code>	the explanatory variable against which the worm plots will be plotted
<code>n.inter</code>	the number of intervals in which the explanatory variable <code>xvar</code> will be cut
<code>xcut.points</code>	the x-axis cut off points e.g. <code>c(20,30)</code> . If <code>xcut.points=NULL</code> then the <code>n.inter</code> argument is activated
<code>overlap</code>	how much overlapping in the <code>xvar</code> intervals. Default value is <code>overlap=0</code> for non overlapping intervals
<code>xlim.all</code>	for the single plot, this value is the x-variable limit, default is <code>xlim.all=4</code>
<code>xlim.worm</code>	for multiple plots, this value is the x-variable limit, default is <code>xlim.worm=3.5</code>
<code>show.given</code>	whether to show the x-variable intervals in the top of the graph, default is <code>show.given=TRUE</code>
<code>line</code>	whether to plot the polynomial line in the worm plot, default value is <code>line=TRUE</code>
<code>ylim.all</code>	for the single plot, this value is the y-variable limit, default value is <code>ylim.all=12*sqrt(1/length(</code>

<code>ylim.worm</code>	for multiple plots, this values is the y-variable limit, default value is <code>ylim.worm=12*sqrt(n.iter)</code>
<code>cex</code>	the cex plotting parameter with default <code>cex=1</code>
<code>pch</code>	the pch plotting parameter with default <code>pch=21</code>
<code>...</code>	for extra arguments

Details

If the `xvar` argument is not specified then a single worm plot is used. In this case a worm plot is a detrended normal QQ-plot so departure from normality is highlighted. If the `xvar` is specified then we have as many worm plot as `n.iter`. In this case the x-variable is cut into `n.iter` intervals with an equal number observations and detrended normal QQ (i.e. worm) plots for each interval are plotted. This is a way of highlighting failures of the model within different ranges of the explanatory variable. The fitted coefficients from fitting cubic polynomials to the residuals (within each x-variable interval) can be obtain by e.g. `coeffs<-wp(modell1,xvar=x,n.iter=9)`. van Buuren *et al.* (2001) used these residuals to identify regions (intervals) of the explanatory variable within which the model does not fit adequately the data (called "model violation")

Value

For multiple plots the `xvar` intervals and the coefficients of the fitted cubic polynomials to the residuals (within each `xvar` interval) are returned.

Author(s)

Mikis Stasinopoulos and Bob Rigby

References

- Rigby, R. A. and Stasinopoulos D. M. (2005). Generalized additive models for location, scale and shape,(with discussion), *Appl. Statist.*, **54**, part 3, 1-38.
- Stasinopoulos D. M., Rigby R.A. and Akantziliotou C. (2006) Instructions on how to use the GAMLSS package in R. Accompanying documentation in the current GAMLSS help files, (see also <http://www.gamlss.com/>).
- Stasinopoulos D. M. Rigby R.A. (2007) Generalized additive models for location scale and shape (GAMLSS) in R. *Journal of Statistical Software*, Vol. **23**, Issue 7, Dec 2007, <http://www.jstatsoft.org/v23/i07>.
- van Buuren and Fredriks M. (2001) Worm plot: simple diagnostic device for modelling growth reference curves. *Statistics in Medicine*, **20**, 1259–1277

See Also

[gamlss](#), [plot.gamlss](#)

Examples

```
data(abdom)
a<-gamlss(y~cs(x,df=3),sigma.fo=~cs(x,1),family=L0,data=abdom)
wp(a)
coeff1<-wp(a,abdom$x)
coeff1
rm(a,a1)
```

Index

*Topic **package**

gamlss-package, 2

*Topic **regression**

additive.fit, 3

bf, 4

centiles, 6

centiles.com, 9

centiles.pred, 10

centiles.split, 12

coef.gamlss, 14

cs, 15

deviance.gamlss, 18

find.hyper, 19

fitted.gamlss, 21

fitted.plot, 23

formula.gamlss, 24

gamlss, 25

gamlss.control, 29

gamlss.cs, 31

gamlss.fp, 32

gamlss.lo, 33

gamlss.ps, 35

gamlss.ra, 36

gamlss.random, 37

gamlss.rc, 38

gamlss.scope, 39

glim.control, 41

histDist, 42

IC, 44

lo, 45

lpred, 47

model.frame.gamlss, 48

par.plot, 50

pdf.plot, 51

plot.gamlss, 53

polyS, 55

predict.gamlss, 56

print.gamlss, 58

prof.dev, 59

prof.term, 61

ps, 62

Q.stats, 65

ra, 66

random, 68

rc, 69

refit, 70

residuals.gamlss, 72

ridge, 73

rqres.plot, 75

stepGAIC, 76

summary.gamlss, 79

term.plot, 81

update.gamlss, 83

VG, 84

wp, 86

additive.fit, 3, 4, 15, 63

AIC.gamlss (IC), 44

bf, 4

centiles, 6, 10, 12–14, 23

centiles.com, 8, 9, 14

centiles.pred, 10

centiles.split, 8, 10, 12, 12, 23, 66

coef.gamlss, 14, 19, 22, 73, 83

cs, 15, 31, 32, 46, 64

cy (ps), 62

deviance.gamlss, 15, 18, 22, 25, 59, 73,
80, 83, 85

extractAIC.gamlss (IC), 44

find.hyper, 19, 29, 67

fitted.gamlss, 15, 19, 21, 22, 25, 59, 73,
80, 83

fitted.plot, 23

formula.gamlss, 22, 24, 73, 83

fp, 33

- fp (*bfpr*), 4
- fv (*fitted.gamlss*), 21
- GAIC (*IC*), 44
- gamlss, 4, 6, 8, 10, 12, 14, 15, 18, 21, 23, 25, 25, 30, 32–34, 36–39, 41, 43, 45, 49, 51, 53–55, 59, 60, 62, 64, 66, 67, 69–71, 74–76, 80, 85, 87
- gamlss-package, 2
- gamlss.control, 26, 29
- gamlss.cs, 15, 18, 31
- gamlss.cy, 63
- gamlss.cy (*gamlss.ps*), 35
- gamlss.family, 2, 6, 19, 26, 27, 29, 43, 85
- gamlss.fp, 4, 32
- gamlss.lo, 33, 55
- gamlss.pb, 63
- gamlss.pb (*gamlss.ps*), 35
- gamlss.pp (*gamlss.fp*), 32
- gamlss.ps, 35, 63, 64
- gamlss.ra, 36
- gamlss.random, 37, 69
- gamlss.rc, 38
- gamlss.ri (*gamlss.ps*), 35
- gamlss.ridge (*gamlss.ps*), 35
- gamlss.scope, 39, 78
- gamlss.scs (*gamlss.cs*), 31
- gamlss.vc (*gamlss.cs*), 31
- gamlssNews (*gamlss*), 25
- glim.control, 27, 41
- histDist, 42
- IC, 44
- is.gamlss (*gamlss*), 25
- lo, 18, 34, 45
- lp, 57
- lp (*lpred*), 47
- lpred, 47, 57
- model.frame.gamlss, 48
- model.matrix.gamlss
(*model.frame.gamlss*), 48
- optim, 21
- par.plot, 50
- pb, 36
- pb (*ps*), 62
- pdf.plot, 29, 51
- plot.gamlss, 21, 22, 53, 73, 76, 83, 87
- poly.matrix (*polyS*), 55
- polyS, 55
- pp (*bfpr*), 4
- predict.gamlss, 48, 56
- predictAll (*predict.gamlss*), 56
- print.gamlss, 22, 58, 73, 83
- prof.dev, 59, 62
- prof.term, 60, 61
- ps, 36, 62
- Q.stats, 65
- ra, 37, 38, 66, 70, 74
- random, 37, 38, 46, 66, 67, 68, 70
- rc, 39, 69
- refit, 30, 70
- residuals.gamlss, 22, 72, 73, 83
- ri (*ridge*), 73
- ridge, 73
- rqres.plot, 72, 75
- scs (*cs*), 15
- stepGAIC, 40, 76
- summary.gamlss, 22, 73, 79, 83
- term.plot, 81
- termplot, 82
- terms.gamlss
(*model.frame.gamlss*), 48
- TGD (*VGD*), 84
- update, 71
- update.gamlss, 22, 71, 73, 83
- vc (*cs*), 15
- VGD, 84
- VGD1 (*VGD*), 84
- VGD2 (*VGD*), 84
- wp, 66, 86