Package 'gamlss.inf'

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Type Package

Title Fitting Mixed (Inflated and Adjusted) Distributions

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Imports methods

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Description This is an add-on package to 'gamlss'. The purpose of this package is to allow users to fit GAMLSS (Generalised Additive Models for Location Scale and Shape) models when the response variable is defined either in the intervals [0,1), (0,1] and [0,1] (inflated at zero and/or one distributions), or in the positive real line including zero (zero-adjusted distributions). The mass points at zero and/or one are treated as extra parameters with the possibility to include a linear predictor for both. The package also allows transformed or truncated distributions from the GAMLSS family to be used for the continuous part of the distribution. Standard methods and GAMLSS diagnostics can be used with the resulting fitted object.

License GPL-2 | GPL-3

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R topics documented:

`gamlss.inf-package` *Models for Mixed (Inflated and Adjusted) Response Variables.*

Description

This package allows mixed distribution fitting in GAMLSS. A mixed distribution is one containing both continuous and discrete parts, see Chapter 5 of Stasinopoulos et al. (2017). There are some mixed distribution in the GAMLSS implementation in R like the `BEINF`, `BEINF0`, `BEINF1` for data defined on [0,1] or `ZAGA`, `ZAIG` for data defined on a positive real line but the choice is very limited. This package enhance the availability of mixed distribution within the GAMLSS framework.

For historical reasons the authors use the terminology "Inflated" for models on [0,1], "Adjusted" for models on [0,Inf]. We will follow the same terminology here. So this package allows the fit of an inflated GAMLSS model when the response variable is defined in the intervals [0,1), (0,1] and [0,1] and the fit of zero adjusted models when the response variable is defined in the positive real line, (but where there are zeros in the data).

For models with inflated proportion response variables the package provides up to two extra parameters, a mass point at zero and a mass point at one. Adding an extra inflation point at zero (or at one), is equivalent to fit two separate GAMLSS models, a GAMLSS model with a continuous distribution defined at the interval (0,1), and a logit model for zero (or ones). When both zero and one are present, i.e. [0,1], a multinomial model is needed to fit the non-(0,1) part.

For the zero adjusted models with a response defined on the positive real line (but where zeros exist in the data), the actual fitting can be achieved by fitting two separate GAMLSS models one with a distribution on the real positive line and one binomial model for the zeros and non-zeros.

This package uses the two models fitting procedures but the resulting fitted object behaves like a typical GAMLSS object so a lot of standard GAMLSS diagnostics can be used with it. It also allows transformed or truncated `gamlss.family` distributions to be used for the continuous part of the distribution therefore giving a great flexibility of the type of mixed distribution to be used.

The functions `gamlssInf0to1()` and `gamlssZadj()` can fit the Inflated and Adjusted models, respectively, and they are described in the two vignettes available with the package.

Details

Package:	gamlss.inf
Type:	Package
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Author(s)

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References

Hossain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. *Statistics in Medicine*, doi: 10.1002/sim.6748.

Ospina R. and Ferrari S. L. P. (2010) Inflated beta distributions, *Statistical Papers*, **23**, 111-126.

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.

Stasinopoulos D. M., Rigby R.A., Heller G., Voudouris V., and De Bastiani F., (2017) *Flexible Regression and Smoothing: Using GAMLSS in R*, Chapman and Hall/CRC. https://www.crcpress.com/Flexible-Regression-and-Smoothing-Using-GAMLSS-in-R/Stasinopoulos-Rigby-Heller-Voudouris-Bastiani/p/book/9781138197909.

See Also

gamlss

Examples

```
# An artificial example using simulated data in [0,1)

# Firstly, we use function gen.Family() to create
# the logit skew student t (logitSST) distribution which is defined in the (0,1)
# interval. Then we use function gen.Inf0to1() to create the 0-inflated logitSST
# distribution defined in [0,1).
```

```
gen.Family("SST", "logit")
gen.Inf0to1("logitSST","Zero")

#now we can generate the data and run the model

set.seed(10)
Y <- rlogitSSTInf0(300,mu=0.5,sigma=0.7,nu=0.5,tau=5,xi0=0.5,log=FALSE)
m1 <- gamlssInf0to1(y=Y,mu.formula=~1,
                    sigma.formula=~1,
                    nu.formula=~1,
                    tau.formula=~1,
                    xi0.formula=~1,
                    family=logitSST,
                    trace = TRUE)
summary(m1)
```

`centiles.Inf0to1` *Plotting centile curves for a* `gamlssInf0to1` *and* `gamlssZadj` *object*

Description

Function `centiles.Inf0to1()` plots centile curves for distributions belonging to the GAMLSS family of distributions defined in the intervals (0,1],[0,1) and [0,1]. 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.Inf0to1(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, points = TRUE,
    pch = 15, cex = 0.5, col = gray(0.7), col.centiles = 1:length(cent) +
        2, lty.centiles = 1, lwd.centiles = 1, ...)
centiles.Zadj(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, points = TRUE,
   pch = 15, cex = 0.5, col = gray(0.7), col.centiles = 1:length(cent) +
   2, lty.centiles = 1, lwd.centiles = 1, ...)
```

Arguments

`obj`	a fitted gamlss object from fitting a gamlss distribution
`xvar`	the unique explanatory variable

cent	a vector with elements the % centile values for which the centile curves have to be evaluated
legend	whether a legend is required in the plot or not, the default is legent=TRUE
ylab	the y-variable label
xlab	the x-variable label
main	the main title here as character. If NULL the default title "centile curves using NO" (or the relevant distributions name) is shown
main.gsub	if the main.gsub (with default "@") appears in the main title then it is substituted with the default title.
xleg	position of the legend in the x-axis
yleg	position of the legend in the y-axis
xlim	the limits of the x-axis
ylim	the limits of the y-axis
save	whether to save the sample percentages or not with default equal to FALSE. In this case the sample percentages are printed but are not saved
plot	whether to plot the centiles
points	whether the data points should be plotted, default is TRUE
pch	the character to be used as the default in plotting points see par
cex	size of character see par
col	plotting colour see par
col.centiles	Plotting colours for the centile curves
lty.centiles	line type for the centile curves
lwd.centiles	The line width for the centile curves
...	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)

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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.org/).

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.

Houssain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. Accepted for publication on *Statistics in Medicine*.

See Also

gamlssInf0to1, gamlss, centiles.split , centiles.com

Examples

```
## Not run:
gen.Family("SST", "logit")
gen.Inf0to1("logitSST","One")
set.seed(30)
x <- seq(0,1,l=2000)
dat <- data.frame(x)
dat$Y <- rlogitSSTInf1(2000,mu=-3+10*x-0.7*x^2,sigma=0.9,nu=0.5,
                       tau=5,xi1=plogis(-0.5*ifelse(x>0.7,-1,13)),log=FALSE)

m1 <- gamlssInf0to1(y=Y,mu.formula=~pb(x), sigma.formula=~pb(x),
                    nu.formula=~pb(x), tau.formula=~pb(x),
                    xi1.formula=~pb(x),
                    data=dat, family=logitSST)

centiles.Inf0to1(m1,xvar= dat$x, cent=c(2,10,25,50,75,90,98),
col.centiles=c(1,7:2),
ylab="proportion", xlab="x",legend=FALSE,main="(c) Inf. logitSST")

## End(Not run)
```

---

gamlssInf0to1 *GAMLSS model for a proportion response variable with point(s) mass at 0 and or 1.*

Description

Function gamlssInf0to1() allows to fit inflated gamlss models when the response variable distribution is defined in the intervals [0,1), (0,1] and [0,1]. The gamlssInf0to1 model for inflated proportion variables is a gamlss model provided of up to two extra parameters for the mass point(s). In the case of inflation point at zero (one), this is equivalent to fit two separate models, a gamlss model for the (0,1) part, and a logit model for zero (one) vs non-zero (non-one) part. When both zero and one are present, a multinomial model is involved to fit the non-(0,1) part.

Usage

```
gamlssInf0to1(y = NULL, mu.formula = ~1, sigma.formula = ~1,
              nu.formula = ~1,tau.formula = ~1,
              xi0.formula = ~1,xi1.formula = ~1, data = NULL,
              family = BE, weights = rep(1, length(Y_)),
              trace = FALSE, ...)
```

Arguments

y	the proportion response variable with inflation at zero and/or one
mu.formula	a model formula for mu
sigma.formula	a model formula for sigma
nu.formula	a model formula for nu
tau.formula	a model formula for tau
xi0.formula	a model formula for the probability at zero
xi1.formula	a model formula for the probability at one
data	a data frame containing the variables occurring in the formula.
family	any gamlss distribution family defined in (0,1)
weights	a vector of weights as in gamlss
trace	logical, if TRUE information on model estimation will be printed during the fitting
...	for extra parameters

Details

The default family is a Beta distribution (BE), but other (0,1) distributions can be used, e.g. those generated from existing continuous gamlss family distributions by using gen.Family with link "logit".

Value

returns a gamlssInf0to1 object which has its own methods

Author(s)

Mikis Stasinopoulos, Robert Rigby, Abu Hossain and Marco Enea

References

Hossain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. *Statistics in Medicine*, doi: 10.1002/sim.6748.

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.org/).

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, BEINF, BE, BEo, BEZI, BEOI

Examples

```
# 1. An artificial example using simulated data

# Firstly, we use function gen.Family() to create the logit skew
# student t (logitSST) distribution defined in the (0,1) interval,
# and function gen.Inf0to1() to create the 0-inflated logitSST
# distribution defined in [0,1).

gen.Family("SST", "logit")
gen.Inf0to1("logitSST","Zero")

#now we can generate the data and run the model
set.seed(10)
Y <- rlogitSSTInf0(500,mu=0.5,sigma=0.7,nu=0.5,tau=5,xi0=0.5,log=FALSE)
dat <- data.frame(Y)
dat$x <- rnorm(500)
m1 <- gamlssInf0to1(y=Y,mu.formula=~x, sigma.formula=~x,
                    nu.formula=~x, tau.formula=~x,
                    xi0.formula=~x,data=dat, family=logitSST)
summary(m1)

# 2. Example of equivalent gamlss models for an inflated-at-1 Beta distribution

Y <- rBEINF1(500,mu=0.5,sigma=0.7,nu=0.5)
m2 <- gamlss(Y~1,sigma.formula=~1,nu.formula=~1,family=BEINF1)
m3.1 <- gamlss(Y[Y<1]~1,sigma.formula=~1,family=BE)
m3.2 <- gamlss(I(Y==1)~1,family=BI)
m4 <- gamlssInf0to1(Y,mu.formula=~1,sigma.formula=~1,xi1=~1,family=BE)
stopifnot(all.equal(deviance(m2),(deviance(m3.1)+deviance(m3.2))),
          all.equal(deviance(m2),deviance(m4)))
```

gamlssZadj *Fitting positive real line response variable with zeros.*

Description

Function gamlssZadj() allows to fit zero adjusted gamlss models when the response variable distribution is defined on the positive real line. The gamlssZadj model for adjusted positive variables is a gamlss model provides one extra parameters for the mass point at zero. This is equivalent to fit two separate models, a gamlss model for the (0,Inf) part, and a logit model for zero part versus the non-zero part. The function works similarly but provides one fitted object.

Usage

```
gamlssZadj(y = NULL, mu.formula = ~1, sigma.formula = ~1,
         nu.formula = ~1, tau.formula = ~1,
         xi0.formula = ~1, data = NULL,
         family = GA,
         weights = rep(1, length(Y_)), trace = FALSE, ...)
```

Arguments

y	the response variable
mu.formula	a model formula for mu
sigma.formula	a model formula for sigma
nu.formula	a model formula for nu
tau.formula	a model formula for tau
xi0.formula	a model formula for xi0
data	a data frame containing the variables occurring in the formula.
family	any gamlss distribution family defined on the rael line
weights	a vector of weights as in gamlss
trace	logical, if TRUE information on model estimation will be printed during the fitting
...	for extra arguments to pass to gamlss

Details

The default family is a gamma distribution (GA), but other distributions on the positive rael line can be used, e.g. those generated from existing continuous gamlss.family distributions using say gen.Family() with "log" or gen.trun() from package **gamlss.tr**

Value

. Returns a gamlssZadj object which has its own methods

Author(s)

Mikis Stasinopoulos, Robert Rigby and Marco Enea

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.org/).

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See Also

gamlss.family, ZAGA, ZAIG

Examples

```
  y0 <- rZAGA(1000, mu=.3, sigma=.4, nu=.15)# p0=0.13
  g0 <- gamlss(y0~1, family=ZAGA)
 t0 <- gamlssZadj(y=y0, mu.formula=~1, family=GA, trace=TRUE)
AIC(g0,t0, k=0)
```

`gen.Inf0to1` *Functions to generate inflated 0-to-1 distributions from existing continuous gamlss.family distributions defined in (0,1).*

Description

There are six functions here. Only the function `gen.Inf0to1()` should be used. The remaing five functions will be automatically created once `gen.Inf0to1()` has been run.

Usage

```
gen.Inf0to1(family = "BE", type.of.Inflation = c( "Zero&One", "Zero", "One"),
            ...)
Inf0to1.d(family = "BE", type.of.Inflation = c( "Zero&One", "Zero", "One"),
            ...)
Inf0to1.p(family = "BE", type.of.Inflation = c( "Zero&One", "Zero", "One"),
            ...)
```

```
Inf0to1.q(family = "BE", type.of.Inflation = c( "Zero&One", "Zero", "One"),
            ...)
Inf0to1.r(family = "BE", type.of.Inflation = c( "Zero&One", "Zero", "One"),
            ...)
plotInf0to1(family = "BE", type.of.Inflation = c( "Zero&One", "Zero", "One"),
            ...)
```

Arguments

`family`	a continuous (0,1) distribution (extremes not included) `gamlss.family` distribution
`type.of.Inflation`	the type of inflation
`...`	for passing extra arguments

Details

Functions `Inf0to1.d`, `Inf0to1.p`, `Inf0to1.q` and `Inf0to1.r` allow to create the density function, distribution function, quantile function and random generation, respectively. Function `plotInf0to1` can be used to create the plot the distributions.

Alternatively, the function `gen.Inf0to1` creates the all the standard `d,p,q,r` functions plus the plotting function.

For example, let us take the case of the logit SST distribution with inflation at 1. First generate the `"logitSST"` distribution by using `gen.Family("SST", "logit")`, and then, by use `gen.Inf0to1("logitSST", "One")`. The functins `dlogitSSTInf1`, `plogitSSTInf1`, `qlogitSSTInf1`, `rlogitSSTInf1` and `plotlogitSSTInf1` will be automatically generated. Note that `gen.Inf0to1` never creates a fitting function of the type "logitSSTInf1", but the existing `logitSST` must be specified instead as an argument `family` of function `gamlssInf0to1()`.

Value

The function `gen.Inf0to1` returns the `d`, `p`, `q` and `r` functions plus the plotting function.

Author(s)

Mikis Stasinopoulos <mikis.stasinopoulos@gamlss.org>, Bob Rigby and Marco Enea

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.

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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.

Stasinopoulos D. M., Rigby R.A., Heller G., Voudouris V., and De Bastiani F., (2017) *Flexible Regression and Smoothing: Using GAMLSS in R*, Chapman and Hall/CRC. https://www.crcpress.com/Flexible-Regression-and-Smoothing-Using-GAMLSS-in-R/Stasinopoulos-Rigby-Heller-Voudouris-Bastip/book/9781138197909.

Examples

```
# 1.
gen.Inf0to1("BE","Zero&One")
rBETAInf0to1 <- Inf0to1.r("BE","Zero&One")
all.equal(rBETAInf0to1, rBEInf0to1)
plotBEInf0to1()
plotBEInf0to1(mu=0.3,sigma=0.35,xi0=0.5,xi1=0.3)

# 2.
gen.Family("SST", "logit")
gen.Inf0to1("logitSST","One")
set.seed(30)

args(rlogitSSTInf1)
y <- rlogitSSTInf1(1000,mu=0.2,sigma=0.5,nu=1,tau=5,xi1=0.2)
quantile(y,c(0.1,0.25,0.5,0.75,0.9))

args(qlogitSSTInf1)
qlogitSSTInf1(p=c(0.1,0.25,0.5,0.75,0.9),mu=0.2,sigma=0.5,nu=1,tau=5,xi1=0.2)
plotlogitSSTInf1(mu=0.2,sigma=0.5,nu=1,tau=5,xi1=0.2)
```

`gen.Zadj` *Functions to generate zero adjusted distributions from existing continuous gamlss.family distributions defined on positve real line.*

Description

There are six functions here. Only the function `gen.Zadj()` should be used. The remaing four functions will be automatically created once `gen.Zadj()` has been run.

Usage

```
gen.Zadj(family = "GA", ...)
Zadj.d(family = "GA", ...)
Zadj.p(family = "GA", ...)
Zadj.q(family = "GA", ...)
Zadj.r(family = "GA", ...)
plotZadj(family = "GA", ...)
```

Arguments

`family`	a continuous positive rael line distribution
`...`	for additional arguments

Details

Functions `Zadj.d`, `Zadj.p`, `Zadj.q` and `Zadj.r` allow to create the density function, distribution function, quantile function and random generation, respectively. Function `plotZadj` can be used to create a plot for the distribution.

Alternatively, the function `gen.Zadj` creates the all the standard `d,p,q,r` functions plus the plotting function.

Value

The function `gen.Zadj` returns the `d`, `p`, `q` and `r` functions plus the plotting function.

Author(s)

Mikis Stasinopoulos <mikis.stasinopoulos@gamlss.org>, Bob Rigby and Marco Enea

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.org/).

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.

Stasinopoulos D. M., Rigby R.A., Heller G., Voudouris V., and De Bastiani F., (2017) *Flexible Regression and Smoothing: Using GAMLSS in R*, Chapman and Hall/CRC. https://www.crcpress.com/Flexible-Regression-and-Smoothing-Using-GAMLSS-in-R/Stasinopoulos-Rigby-Heller-Voudouris-Bastiani/p/book/9781138197909.

See Also

gamlssZadj, ~~~

Examples

```
# 1.
gen.Zadj("BCT")

plotBCTZadj()
plotBCTZadj(mu=3,sigma=0.35,xi0=0.5)

# 2.
gen.Family("SST", "log")
gen.Zadj("logSST")
 plotlogSSTZadj()
```

`predict.gamlssinf0to1` *Extract Predictor Values and Standard Errors For New Data In a gamlssinf0to1 Model*

Description

`predict.gamlssinf0to1` is the gamlssinf0to1 specific method which produce predictors for a new data set for a specified parameter from a gamlssinf0to1 objects. The `predict.gamlssinf0to1` 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 'gamlssinf0to1'
predict(object, parameter = c("mu", "sigma", "nu", "tau", "xi0","xi1"),
 newdata = NULL, type = c("link", "response", "terms"),
   terms = NULL, se.fit = FALSE,data = NULL, ...)
```

Arguments

`object`	a gamlssinf0to1 fitted model
`parameter`	which distribution (or inflation) parameter is required, default `parameter="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 (or inflation) 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.

Author(s)

Abu Hossain, Mikis Stasinopoulos <mikis.stasinopoulos@gamlss.org>, Bob Rigby and Marco Enea

References

Hossain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. *Statistics in Medicine*, doi: 10.1002/sim.6748.

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.org/).

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

gamlssInf0to1

Examples

```
gen.Family("SST", "logit")
gen.Inf0to1("logitSST","Zero")
set.seed(10)
Y <- rlogitSSTInf0(500,mu=0.5,sigma=0.7,nu=0.5,tau=5,xi0=0.5,log=FALSE)
dat <- data.frame(Y)
dat$x <- rnorm(500)
m1 <- gamlssInf0to1(y=Y,mu.formula=~x, sigma.formula=~x,
                    nu.formula=~x, tau.formula=~x,
                    xi0.formula=~x,data=dat, family=logitSST)
predict(m1)
```

`predict.gamlssZadj` *Extract Predictor Values and Standard Errors For New Data in a gamlssZadj Model*

Description

`predict.gamlssZadj` is the specific method which produce predictors for a new data set for a specified parameter from a gamlssZadj objects. The `predict.gamlssZadj` 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 'gamlssZadj'
predict(object, parameter = c("mu", "sigma", "nu", "tau", "xi0"),
 newdata = NULL, type = c("link", "response", "terms"),
   terms = NULL, se.fit = FALSE,data = NULL, ...)
```

Arguments

`object`	a gamlssZadj fitted model
`parameter`	which distribution (or inflation) parameter is required, default `parameter="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 (or inflation) 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.

Author(s)

Abu Hossain, Mikis Stasinopoulos <mikis.stasinopoulos@gamlss.org>, Bob Rigby and Marco Enea

References

Hossain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. *Statistics in Medicine*, doi: 10.1002/sim.6748.

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.org/).

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

gamlssZadj

Examples

```
set.seed(3210)
x <- (runif(800)*4)-2
data(sda)
fmu <- splinefun(sda$x, sda$mu)
curve(fmu, -2,2)
fsigma <- splinefun(sda$x, sda$sigma)
curve(fsigma, -2,2)
fnu <- function(x)
  {f <- splinefun(sda$x, sda$nu)
f(x)/6
}
curve(fnu, -2,2)
set.seed(321)
y0 <- rZAGA(800, mu=fmu(x), sigma=fsigma(x), nu=fnu(x))
da <- data.frame(y0,x)
g0p <- gamlss(y0~pb(x), sigma.fo=~pb(x), nu.fo=~pb(x), data=da, family=ZAGA)
t0p <- gamlssZadj(y=y0, mu.fo=~pb(x), sigma.fo=~pb(x),data=da,
                  trace=TRUE, xi0.fo=~pb(x), family="GA")

plot(predict(g0p,"nu",type="link"),
     predict(t0p,"xi0",type="link"))
```

sda *Data for using for simulation*

Description

Those data values are used to create simaulated data

Usage

```
data("sda")
```

Format

A data frame with 120 observations on the following 5 variables.

`x` the explanatory variable

`mu` the fitted mu

`sigma` the fitted sigma

`nu` the fitted nu

`tau` the fitted tau

Source

The data are fitted values of model

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.org/).

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.

Stasinopoulos D. M., Rigby R.A., Heller G., Voudouris V., and De Bastiani F., (2017) *Flexible Regression and Smoothing: Using GAMLSS in R*, Chapman and Hall/CRC. https://www.crcpress.com/Flexible-Regression-and-Smoothing-Using-GAMLSS-in-R/Stasinopoulos-Rigby-Heller-Voudouris-Basti
p/book/9781138197909.

Examples

```
data(sda)
fmu <- splinefun(sda$x, sda$mu)
curve(fmu, -2,2)
fsigma <- splinefun(sda$x, sda$sigma)
curve(fsigma, -2,2)
fnu <- splinefun(sda$x, sda$nu)
curve(fnu, -2,2)
ftau <- splinefun(sda$x, sda$tau)
curve(ftau, -2,2)
```

---

summary.gamlssinf0to1 *Summarizes an inflated GAMLSS fitted model*

Description

These are specific methods for the generic function summary which summarize objects retuned by gamlssinf0to1 or gamlssZadj.

Usage

```
## S3 method for class 'gamlssinf0to1'
summary(object, type = c("vcov", "qr"),
       robust=FALSE, save = FALSE, hessian.fun = c("R", "PB"),
       digits = max(3, getOption("digits") - 3),...)

## S3 method for class 'gamlssZadj'
summary(object, type = c("vcov", "qr"),
       robust=FALSE, save = FALSE, hessian.fun = c("R", "PB"),
       digits = max(3, getOption("digits") - 3),...)
```

Arguments

object	a gamlssinf0to1 or gamlssZadj 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, while the inflation parameters xi0 and xi1 are uncorrelated anywway.
robust	whether robust (sandwich) standard errors are required
save	whether to save the environment of the function so to have access to its values
hessian.fun	whether when calculate the Hessian should use the "R" function optimHess() or a function based on Pinheiro and Bates nlme package, "PB".
digits	the number of digits in the output
...	for extra arguments

Details

Using the default value `type="vcov"`, the `vcov()` method 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 take into the account the inter-correlation between the 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 gamlssinf0to1 or a gamlssZadj object

Author(s)

Abu Hossain, Mikis Stasinopoulos <mikis.stasinopoulos@gamlss.org>, Bob Rigby and Marco Enea

References

Houssain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. Accepted for publication on *Statistics in Medicine*.

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.org/).

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

gamlssInf0to1, gamlssZadj

Examples

```
# The gamlssZadj example
set.seed(3210)
x <- (runif(1000)*4)-2
data(sda)
fmu <- splinefun(sda$x, sda$mu)
fsigma <- splinefun(sda$x, sda$sigma)
fnu <- function(x)
  {f <- splinefun(sda$x, sda$nu)
f(x)/6
}
```

```
y0 <- rZAGA(1000, mu=fmu(x), sigma=fsigma(x), nu=fnu(x))
da <- data.frame(y0,x)
t0p <- gamlssZadj(y=y0, mu.fo=~pb(x), sigma.fo=~pb(x),data=da,
                  trace=TRUE, xi0.fo=~pb(x), family="GA")
summary(t0p)
```

`term.plotInf0to1` *Plot regression terms for a specified parameter of a fitted gamlssInf0to1 object*

Description

This is a wrapper to function `term.plot`. `term.plotInf0to1` produces term plots for a specified parameter from a gamlssinf0to1 object.

Usage

```
term.plotInf0to1(object, parameter = c("mu", "sigma", "nu", "tau",
        "xi0", "xi1"),...)
```

Arguments

`object`	a gamlssinf0to1 fitted model
`parameter`	which distribution (or inflation) parameter is required, default `parameter="mu"`
`...`	extra arguments, the same of `term.plot` (except 'what')

Details

see function term.plot

Value

A plot of fitted terms.

Author(s)

Marco Enea, Mikis Stasinopoulos, Bob Rigby and Abu Hossain

References

Hossain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. *Statistics in Medicine*, doi: 10.1002/sim.6748.

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.org/).

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

gamlssInf0to1

Examples

```
gen.Family("SST", "logit")
gen.Inf0to1("logitSST","Zero")
set.seed(10)
Y <- rlogitSSTInf0(500,mu=0.5,sigma=0.7,nu=0.5,tau=5,xi0=0.5,log=FALSE)
dat <- data.frame(Y)
dat$x <- rnorm(500)
m1 <- gamlssInf0to1(y=Y,mu.formula=~x, sigma.formula=~x,
                    nu.formula=~x, tau.formula=~x,
                    xi0.formula=~x,data=dat, family=logitSST)

# term.plot for the mu parameter
term.plot(m1$dist,parameter="mu")
term.plotInf0to1(m1,parameter="mu",col.shaded = 2)

# term.plot for the binomial parameter
term.plot(m1$multinom,parameter="mu")
term.plotInf0to1(m1,parameter="xi0",col.shaded = 2)
```

`term.plotZadj` *Plot regression terms for a specified parameter of a fitted gamlssZadj object*

Description

\ This is a wrapper to function term.plot. codeterm.plotZadj produces term plots for a specified parameter from a gamlssZadjobject.

Usage

```
term.plotZadj(object, parameter = c("mu", "sigma", "nu", "tau", "xi0"),...)
```

Arguments

`object`	a gamlssZadj fitted model
`parameter`	which distribution (or inflation) parameter is required, default `parameter="mu"`
`...`	extra arguments, the same of term.plot (except 'what')

Details

see function term.plot

Value

A plot of fitted terms.

Author(s)

Marco Enea, Mikis Stasinopoulos, Bob Rigby and Abu Hossain

References

Hossain, A., Stasinopoulos, M., Rigby, R. and Enea, M. (2015). Centile estimation for a proportion response variable. *Statistics in Medicine*, doi: 10.1002/sim.6748.

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.org/).

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

gamlssZadj

Examples

```
set.seed(3210)
x <- (runif(1000)*4)-2
data(sda)
fmu <- splinefun(sda$x, sda$mu)
curve(fmu, -2,2)
fsigma <- splinefun(sda$x, sda$sigma)
curve(fsigma, -2,2)
fnu <- function(x)
  {f <- splinefun(sda$x, sda$nu)
f(x)/6
}
```

```
curve(fnu, -2,2)
set.seed(321)
y0 <- rZAGA(1000, mu=fmu(x), sigma=fsigma(x), nu=fnu(x))
da <- data.frame(y0,x)
g0p <- gamlss(y0~pb(x), sigma.fo=~pb(x), nu.fo=~pb(x), data=da, family=ZAGA)
t0p <- gamlssZadj(y=y0, mu.fo=~pb(x), sigma.fo=~pb(x),data=da,
                  trace=TRUE, xi0.fo=~pb(x), family="GA")

# term.plot for the mu parameter
term.plot(g0p);title("gamlss")
term.plot(t0p$dist,"mu");title("gamlssZadj")
term.plotZadj(t0p,"mu",col.shaded = 3);title("gamlssZadj")



# term.plot for the sigma parameter
term.plot(g0p, "sigma");title("gamlss")
term.plot(t0p$dist,"sigma");title("gamlssZadj")
term.plotZadj(t0p,"sigma",col.shaded = 3);title("gamlssZadj")

# term.plot for the binomial parameter
term.plot(g0p, "nu");title("gamlss")
term.plot(t0p$binom,"mu");title("gamlssZadj")
term.plotZadj(t0p,"xi0",col.shaded = 3);title("gamlssZadj")
```

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