Package 'twopDist'

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Description This package fits some asymmetric models and
asymmetric distributions by maximum likelihood estimation (MLE) or penalized MLE.

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R topics documented:

TPLapD *Two-piece Laplace Distribution*

Description

Density, distribution function, quantile function and random generation for the 3-parameter two-piece Laplace distribution (TPLapD). The 2-parameter TPLapD may be used for classical quantile regression.

Usage

```
dtwoplaplace(x, location = 0, scale = 1, skewpar = 0.5, log.arg = FALSE)
ptwoplaplace(q, location = 0, scale = 1, skewpar = 0.5)
qtwoplaplace(p, location = 0, scale = 1, skewpar = 0.5)
rtwoplaplace(n, location = 0, scale = 1, skewpar = 0.5)
```

Arguments

x, q	vector of quantiles.
p	vector of probabilities.
n	number of observations. If length(n) > 1 then the length is taken to be the number required.
location	location parameter.
scale	positive scale parameter.
skewpar	skew/asymmetric parameter, between zero and one.
log.arg	Logical. If log.arg = TRUE then the logarithm of the density is returned.

Value

dtwoplaplace gives the density, ptwoplaplace gives the distribution function, qtwoplaplace gives the quantile function, and rtwoplaplace generates random deviates.

Author(s)

Arash Ardalan

Examples

```
location = 0; scale = 1.5; skewpar = 0.25; nn = 201
x = seq(-3.5 ,6.5, len = nn)
y = dtwoplaplace(x, location, scale, skewpar)

## Not run:
plot(x, y, type = "l", las = 1, ylim = c(0, 1.2), ylab =
     paste("ftwoplaplace(location = ", location, ", scale = ", scale,
                   ", skewpar = ", skewpar, ")"),
     col  = "blue", cex.main = 0.8,
     main = "Blue is density, red is cumulative distribution function",
     sub  = "Purple lines are the 10, 20, ..., 90 percentiles")
lines(x, ptwoplaplace(x, location, scale, skewpar), col = "red")
probs = seq(0.1, 0.9, by = 0.1)
```

```
Q = qtwoplaplace(probs, location, scale, skewpar)
lines(Q, dtwoplaplace(Q, location, scale, skewpar), col = "purple",
      lty = 3, type = "h")
lines(Q, ptwoplaplace(Q, location, scale, skewpar), col = "purple",
      lty = 3, type = "h")
abline(h = probs, col = "purple", lty = 3)
abline(h = 0, col = "gray")
max(abs(ptwoplaplace(Q, location, scale, skewpar) - probs)) # Should be 0

## End(Not run)
```

TPLogisD *Two-piece Logistic Distribution*

Description

Density, distribution function, quantile function and random generation for the 3-parameter two-piece logistic distribution (TPLogisD). The 2-parameter TPLogisD may be used for quantile/expectile type regression. This family also is more efficient and more robust in comparison with classical quantile regression.

Usage

```
dtwoplogis(x, location = 0, scale = 1, skewpar = 0.5, log.arg = FALSE)
ptwoplogis(q, location = 0, scale = 1, skewpar = 0.5)
qtwoplogis(p, location = 0, scale = 1, skewpar = 0.5)
rtwoplogis(n, location = 0, scale = 1, skewpar = 0.5)
```

Arguments

x, q	vector of quantiles.
p	vector of probabilities.
n	number of observations. If length(n) > 1 then the length is taken to be the number required.
location	location parameter.
scale	positive scale parameter.
skewpar	skew/asymmetric parameter, between zero and one.
log.arg	Logical. If log.arg = TRUE then the logarithm of the density is returned.

Details

See twoplogis3 and twoplogis , the **twopDist** family function for estimating the parameters, for the formula of the probability density function and other details.

Value

dtwoplogis gives the density, ptwoplogis gives the distribution function, qtwoplogis gives the quantile function, and rtwoplogis generates random deviates.

Author(s)

Arash Ardalan

See Also

twoplogis3 .

Examples

```
location = 1; scale = 1.2; skewpar = 0.25; nn = 201
  # location = 1, scale  = 1.2;
x = seq(-1.5 , 6.5, len=nn)
y =  dtwoplogis(x, location, scale, skewpar)

## Not run:
plot(x, y, type="l", las=1, ylim = c(0, 1.2), ylab =
      paste("ftwoplogis(location=", location, ", scale=", scale,
                    ", skewpar=", skewpar, ")"),
      col="blue", cex.main = 0.8,
      main="Blue is density, red is cumulative distribution function",
      sub="Purple lines are the 10, 20, ..., 90 percentiles")
lines(x, ptwoplogis(x, location, scale, skewpar), col="red")
probs = seq(0.1, 0.9, by = 0.1)
Q = qtwoplogis(probs, location, scale, skewpar)
lines(Q, dtwoplogis(Q, location, scale, skewpar), col = "purple",
          lty = 3, type = "h")
lines(Q, ptwoplogis(Q, location, scale, skewpar), col = "purple",
           lty = 3, type = "h")
abline(h = probs, col = "purple", lty = 3)
abline(h = 0,col= "gray")
max(abs(ptwoplogis(Q, location, scale, skewpar) - probs)) # Should be 0

## End(Not run)
```

TPNormD *Two-piece Normal Distribution*

Description

Density, distribution function, quantile function and random generation for the 2 and 3-parameter two-piece normal distribution (TPND). The 2-parameter TPND may be used for quantile/expectile regression.

Usage

```
dtwopnorm(x, location = 0, scale = 1, skewpar = 0.5, log.arg = FALSE)
ptwopnorm(q, location = 0, scale = 1, skewpar = 0.5)
qtwopnorm(p, location = 0, scale = 1, skewpar = 0.5)
rtwopnorm(n, location = 0, scale = 1, skewpar = 0.5)
```

Arguments

x, q	vector of quantiles.
p	vector of probabilities.
n	number of observations. If length(n) > 1 then the length is taken to be the number required.
location	location parameter.
scale	positive scale parameter.
skewpar	skew/asymmetric parameter, between zero and one.
log.arg	logical. If log.arg = TRUE then the logarithm of the density is returned.

Details

See twopnorm3 and twopnorm, the **twopDist** family function for estimating the parameters, for the formula of the probability density function and other details.

Value

dtwopnorm gives the density, ptwopnorm gives the distribution function, qtwopnorm gives the quantile function, and rtwopnorm generates random deviates.

Author(s)

Arash Ardalan

See Also

twopnorm3

Examples

```
location = 1; scale = 1.2; skewpar = 0.25; nn = 201
x = seq(-1.5 , 6.5, len = nn)
y =  dtwopnorm(x, location, scale, skewpar)

## Not run:
plot(x, y, type = "l", las = 1, ylim = c(0, 1.2), ylab =
      paste("twopnorm(location = ", location, ", scale = ", scale,
                    ", skewpar = ", skewpar, ")"),
      col = "blue", cex.main = 0.8,
      main = "Blue is density, red is cumulative distribution function",
      sub = "Purple lines are the 10, 20, ..., 90 percentiles")
lines(x, ptwopnorm(x, location, scale, skewpar), col = "red")
probs = seq(0.1, 0.9, by = 0.1)
Q = qtwopnorm(probs, location, scale, skewpar)
lines(Q, dtwopnorm(Q, location, scale, skewpar), col = "purple",
       lty = 3, type = "h")
lines(Q, ptwopnorm(Q, location, scale, skewpar), col = "purple",
       lty = 3, type = "h")
abline(h = probs, col = "purple", lty = 3)
abline(h = 0, col = "gray")
max(abs(ptwopnorm(Q, location, scale, skewpar) - probs)) # Should be 0

## End(Not run)
```

TPNormLapD *Two-piece Laplace Distribution*

Description

Density, distribution function, quantile function and random generation for the 3-parameter two-piece normal Laplace distribution (TPNormLapD). This distribution from one side is short tail(normal) and in the other side(Laplace) is long tail, see Ardalan et. All (2012). The 2-parameter TPNorm-LapD may be used for quantile type regression model.

Usage

```
dtwopnormlap(x, location = 0, scale = 1, skewpar = 0.5, log.arg = FALSE)
ptwopnormlap(q, location = 0, scale = 1, skewpar = 0.5)
qtwopnormlap(p, location = 0, scale = 1, skewpar = 0.5)
rtwopnormlap(n, location = 0, scale = 1, skewpar = 0.5)
```

Arguments

x, q	vector of quantiles.
p	vector of probabilities.
n	number of observations. If length(n) > 1 then the length is taken to be the number required.
location	location parameter.
scale	positive scale parameter.
skewpar	skew/asymmetric parameter, between zero and one.
log.arg	Logical. If log.arg = TRUE then the logarithm of the density is returned.

Value

dtwopnormlap gives the density, ptwopnormlap gives the distribution function, qtwopnormlap gives the quantile function, and rtwopnormlap generates random deviates.

Author(s)

Arash Ardalan

References

Arash Ardalan, S. M. Sadooghi-Alvandi and A.N. Nematollahi (2012), The Two-Piece Normal-Laplace Distribution, 35 pages (Comm. in Statist.: Theory & Methods. Accepted).

Examples

```
location = 0; scale = 1.5; skewpar = 0.5; nn = 201
x = seq(-3.5 , 6.5, len = nn)
y = dtwopnormlap(x, location, scale, skewpar)

## Not run:
```

```
plot(x, y, type = "l", las = 1, ylim = c(0, 1.2), ylab =
      paste("ftwopnormlap(location=", location, ", scale=", scale,
                    ", skewpar=", skewpar, ")"),
      col  = "blue", cex.main = 0.8,
      main = "Blue is density, red is cumulative distribution function",
      sub  = "Purple lines are the 10, 20, ..., 90 percentiles")
lines(x, ptwopnormlap(x, location, scale, skewpar), col = "red")
probs = seq(0.1, 0.9, by = 0.1)
Q = qtwopnormlap(probs, location, scale, skewpar)
lines(Q, dtwopnormlap(Q, location, scale, skewpar), col = "purple",
       lty = 3, type = "h")
lines(Q, ptwopnormlap(Q, location, scale, skewpar), col = "purple",
       lty = 3, type = "h")
abline(h = probs, col = "purple", lty = 3)
abline(h = 0,col = "gray")
max(abs(ptwopnormlap(Q, location, scale, skewpar) - probs)) # Should be 0

## End(Not run)
```

TPTD *Two-piece Student's t-distribution*

Description

Density, distribution function, quantile function and random generation for the 5-parameter two-piece Student's t-distribution (TPTD). The 2-parameter TPTD (with given skewpar, dfL and dfR) may be used for quantile type regression.

Usage

```
dtwopt(x, location = 0, scale = 1, skewpar = 0.5, dfL = 2, dfR = 2,
        log.arg = FALSE)
ptwopt(q, location = 0, scale = 1, skewpar = 0.5, dfL = 2, dfR = 2)
qtwopt(p, location = 0, scale = 1, skewpar = 0.5, dfL = 2, dfR = 2)
rtwopt(n, location = 0, scale = 1, skewpar = 0.5, dfL = 2, dfR = 2)
```

Arguments

x, q	vector of quantiles.
p	vector of probabilities.
n	number of observations. If `length(n) > 1` then the length is taken to be the number required.
location	location parameter.
scale	positive scale parameter.
skewpar	skew/asymmetric parameter, between zero and one.
log.arg	logical. If `log.arg = TRUE` then the logarithm of the density is returned.
dfL	the left degree of freedom.
dfR	the right degree of freedom.

Value

dtwopt gives the density, ptwopt gives the distribution function, qtwopt gives the quantile function, and rtwopt generates random deviates.

Author(s)

Arash Ardalan

Examples

```
location = 0; scale = 1.5; skewpar = 0.25; nn = 201
x = seq(-3.5 ,6.5, len = nn)
y = dtwopt(x, location, scale, skewpar)

## Not run:
plot(x, y, type = "l", las = 1, ylim = c(0, 1.2), ylab =
      paste("ftwopt(location = ", location, ", scale = ", scale,
            ", dfL = dfR = ", 2, ", skewpar = ", skewpar, ")"),
      col  = "blue", cex.main = 0.8,
      main = "Blue is density, red is cumulative distribution function",
      sub  = "Purple lines are the 10, 20, ..., 90 percentiles")
lines(x, ptwopt(x, location, scale, skewpar), col = "red")

probs = seq(0.1, 0.9, by = 0.1)
Q = qtwopt(probs, location, scale, skewpar)
lines(Q, dtwopt(Q, location, scale, skewpar), col = "purple",
       lty = 3, type = "h")
lines(Q, ptwopt(Q, location, scale, skewpar), col = "purple",
       lty = 3, type = "h")
abline(h = probs, col = "purple", lty = 3)
abline(h = 0, col = "gray")
max(abs(ptwopt(Q, location, scale, skewpar) - probs)) # Should be 0

## End(Not run)
```

---

twoplogistic *Two-piece Logistic Distribution Family Function*

Description

Maximum likelihood estimation of the 1, 2 and 3-parameter two-piece logistic distributions (TPLogisD). The 1-parameter TPLogisD may be used for quantile type regression.

Usage

```
twoplogis(skewpar = 0.5, llocation = "identity", lscale = "loge",
          elocation = list(), escale = list(), iscale = NULL,
          parallelLocation = FALSE, digt = 2, sameScale = TRUE,
          intparloc = FALSE, imethod = 1, zero =  -2)

twoplogis3(llocation  = "identity", elocation = list(),
```

```
lscale      = "identity",     escale = list(),
lskewpar    = "identity",   eskewpar = list(),
imethod = 1, zero = 2:3)
```

Arguments

skewpar	Numeric vectors with $0 < skewpar < 1$. Most users will only specify $skewpar$ since the estimated location parameter corresponds to the pth regression quantile/expectile, which is easier to understand. See below for details.
llocation, lscale, lskewpar	Character. Parameter link functions for location parameter μ, scale parameter σ, asymmetry parameter $skewpar$.
elocation, escale, eskewpar	List. Extra argument for each of the links. See earg in Links for general information.
iscale	Optional initial values. If given, it must be numeric and values are recycled to the appropriate length. The default is to choose the value internally.
parallelLocation, intparloc	Logical. Should the quantiles be parallel on the transformed scale (argument llocation)? Assigning this argument to TRUE circumvents the seriously embarrassing quantile crossing problem. The argument intparloc applies to intercept term; the argument parallelLocation applies to other terms.
digt	Passed into Round as the digits argument for the tau values; used cosmetically for labelling.
sameScale	Logical. Should the scale parameters be equal? It is advised to keep sameScale=TRUE unchanged because it does not make sense to have different values for each tau value.
imethod	Initialization method. Either the value 1, 2, 3 or 4.
zero	See CommonVGAMffArguments for more information. Where possible, the default is to model all the σ and $skewpar$ as an intercept-only term.

Details

These **twopDist** family functions implement one variant of two-piece logistic distribution (TPLogisD) suitable for quantile/expectile regression. Its density function is

$$f(y;\mu,\sigma,p) = \frac{1}{4\sigma} \begin{cases} sech^2\left(\frac{(y-\mu)}{4\sigma\, p}\right), & y < \mu, \\ sech^2\left(\frac{(y-\mu)}{4\sigma\,(1-p)}\right), & y \geq \mu. \end{cases}$$

Here, the ranges are for all real y and μ, positive σ and positive p.

The special case $p = 0.5$ corresponds to the (symmetric) logistic distribution.

The enumeration of the linear/additive predictors used here is to first have all the location parameters, followed by all the scale parameters. Finally, for twoplogis3() , the last one is the asymmetry parameter.

It is known that the maximum likelihood estimate of the location parameter μ corresponds to the regression quantile/ expectile estimate of the classical quantile regression approach. An important property of the this family is that $P(Y \leq \mu) = p$.

Thus twoplogis() may be used as an alternative to rq in the **quantreg** package.

In general, the response must be a vector or a 1-column matrix.

Value

An object of class "vglmff" (see vglmff-class). The object is used by modelling functions such as vglm and vgam.

In the extra slot of the fitted object are some list components which are useful, e.g., the sample proportion of values which are less than the fitted quantile curves.

Note

The **VGAM** family functions use Fisher scoring. Convergence may be slow and half-stepping is usual (although one can use trace = TRUE to see which is the best model and then set maxit to fit that model).

Author(s)

Arash Ardalan

References

Ardalan, A. and Yee, T. W. (2012), Expectile/quantile regression via two-piece distributions. In preparation.

See Also

twopnorm, lms.bcn.

Examples

```
# Example 1: Logistic quantile regression
# (1) Preprocessing the data

website = "http://www.stat.auckland.ac.nz/~lee/330/datasets.dir/chd.txt"
chd.df = read.table(website, header = TRUE)

myskew = (1:9) / 10
fit0 <- vglm(chd ~ age,
             fam  = twoplogis(llocation = "logit", skewpar = myskew,
                              imethod = 1, parallelLoc = TRUE),
             data = chd.df, trace = TRUE)

fit1 <- vglm(chd ~ bs(age, df = 3),
             fam  = twoplogis(llocation = "logit", skewpar = myskew,
                              imethod = 1, parallelLoc = TRUE),
             data = chd.df, trace = TRUE)

# Plot the results
## Not run:
plotObject1 = fit1
plotObject0 = fit0

plot(jitter(chd, 0.2) ~ age, data = chd.df, col = "blue", las = 1)
for (ii in 1:plotObject0@extra$NOS) {
  ooo = with(chd.df, order(age))
  lines(fitted(plotObject0)[ooo, ii] ~ age[ooo], data = chd.df,
```

```
          col = "orange", lwd = 2)
}

## End(Not run)
# Example 2: quantile regression with B-splines

# (1) Preprocessing the data and sort by wave heights:
require("ismev")
data(wavesurge, package = "ismev")

oo = with(wavesurge, order(wave))

wavesurge  = wavesurge[oo, ]

# (2) Scatter plot

## Not run:
plot(surge ~ wave, main = "10:10:90 percentile curves",
     col = "blue", las = 1, pch = 21, cex = 0.8,
     bg = "black", data = wavesurge)

## End(Not run)

# (3) A preliminary fit

myskew = seq(0.10, 0.90, by = 0.1) # A vector!!
fit = vglm(surge ~ bs(wave, degree = 2), data = wavesurge,
           trace = TRUE, fam = twoplogis(myskew))

fit@extra # Gives some info
coef(fit, matrix = TRUE)

# (4) The regression curves
## Not run:
with(wavesurge, matplot(wave, fitted(fit), type = "l",
                        lty = 1:ncol(fitted(fit)), lwd = 3,
                        add = TRUE, col = 1:ncol(fitted(fit))))

text(11, tail(fitted(fit), 1), paste(myskew * 100, "%"))




## End(Not run)
```

---

twopnorm *Two-piece Normal Distribution Family Function*

Description

Maximum likelihood estimation of the 2 and 3-parameter two-piece normal distributions (TPND). The 1-parameter TPND may be used for quantile/expectile regression.

Usage

```
twopnorm(skewpar = 0.5, llocation = "identity", lscale = "loge",
         elocation = list(), escale = list(), iscale = NULL,
         parallelLocation = FALSE, digt = 2, sameScale = TRUE,
         intparloc = FALSE, imethod = 1, zero =  -2)

twopnorm3(llocation = "identity", elocation = list(),
          lscale     = "identity",     escale = list(),
          lskewpar   = "identity",   eskewpar = list(),
          imethod = 1, zero = 2:3)
```

Arguments

skewpar	Numeric vectors with $0 < skewpar < 1$. Most users will only specify $skewpar$ since the estimated location parameter corresponds to the pth regression quantile/expectile, which is easier to understand. See below for details.
llocation, lscale, lskewpar	Character. Parameter link functions for location parameter μ, scale parameter σ, asymmetry parameter $skewpar$.
elocation, escale, eskewpar	List. Extra argument for each of the links. See earg in Links for general information.
iscale	Optional initial values. If given, it must be numeric and values are recycled to the appropriate length. The default is to choose the value internally.
parallelLocation, intparloc	Logical. Should the quantiles be parallel on the transformed scale (argument llocation)? Assigning this argument to TRUE circumvents the seriously embarrassing quantile crossing problem. The argument intparloc applies to intercept term; the argument parallelLocation applies to other terms.
digt	Passed into Round as the digits argument for the tau values; used cosmetically for labelling.
sameScale	Logical. Should the scale parameters be equal? It is advised to keep sameScale=TRUE unchanged because it does not make sense to have different values for each tau value.
imethod	Initialization method. Either the value 1, 2, 3 or 4.
zero	See CommonVGAMffArguments for more information. Where possible, the default is to model all the σ and $skewpar$ as an intercept-only term.

Details

These **twopDist** family functions implement one variant of two-piece normal distribution (TPND) suitable for quantile/expectile regression. Its density function is

$$f(y;\mu,\sigma,p) = \frac{1}{\sigma\sqrt{2\pi}} \begin{cases} \exp\left(-\frac{(y-\mu)^2}{8\sigma^2\, p^2}\right), & y < \mu, \\ \exp\left(-\frac{(y-\mu)^2}{8\sigma^2\,(1-p)^2}\right), & y \geq \mu. \end{cases}$$

Here, the ranges are for all real y and μ, positive σ and positive p.

The special case $p = 0.5$ corresponds to the (symmetric) normal distribution.

The enumeration of the linear/additive predictors used here is to first have all the location parameters, followed by all the scale parameters. Finally, for twopnorm3(), the last one is the asymmetry parameter.

It is known that the maximum likelihood estimate of the location parameter μ corresponds to the regression quantile/ expectile estimate of the classical quantile regression approach. An important property of the TPND is that $P(Y \leq \mu) = p$.

Thus twopnorm() may be used as an alternative to rq in the **quantreg** package.

In general, the response must be a vector or a 1-column matrix.

Value

An object of class "vglmff" (see vglmff-class). The object is used by modelling functions such as vglm and vgam.

In the extra slot of the fitted object are some list components which are useful, e.g., the sample proportion of values which are less than the fitted quantile curves.

Note

The **VGAM** family functions use Fisher scoring. Convergence may be slow and half-stepping is usual (although one can use trace = TRUE to see which is the best model and then use maxit to fit that model).

Author(s)

Arash Ardalan

References

Ardalan, A. and Yee, T. W. (2012), Expectile/quantile regression via two-piece distribution. In preparation.

See Also

dtwopnorm, lms.bcn.

Examples

```
# Example 1: quantile regression with smoothing splines

# (1) Preprocessing the data
data(mmt, package = "VGAM")
melb = data.frame(today     = tail(mmt, -1),
                  yesterday = head(mmt, -1))

# Sort by yesterday's temperature:
ooo = with(melb, order(yesterday))
melb = melb[ooo,]
head(melb)

# (2) Scatter plot
## Not run:
plot(today ~ yesterday, data = melb, las = 1,
```

```
      xlab = "Yesterday's Max Temperature",
      ylab = "Today's Max Temperature",
      main = "Melbourne Temperature Data",
      pch = 0, cex = 0.25, col = "blue")
abline(a = 0, b = 1, lty = "dashed")

## End(Not run)
# (3) A preliminary fit
myskew = seq(0.10, 0.90, by = 0.1) # A vector!!
fit = vgam(today ~  s(yesterday, df = 4), data = melb,
           trace = TRUE,
           fam = twopnorm(myskew))

fit@extra # Gives some info
coef(fit, matrix = TRUE)

# (4) The regression curves
## Not run:
with(melb, matplot(yesterday, fitted(fit), type = "l",
                   lty = 1:ncol(fitted(fit)),
                   lwd = 3,
                   add = TRUE, col = 1:ncol(fitted(fit))))

text(42, tail(fit
ted(fit), 1), paste(myskew * 100, "%"))

## End(Not run)
```

---

twopnormlap *Two-piece Normal Laplace Distribution Family Function*

Description

Maximum likelihood estimation of the 1 and 2-parameter two-piece normal Laplace distributions (TPNLD). The 1-parameter TPND may be used for quantile/expectile regression.

Usage

```
twopnormlap(skewpar = 0.5, llocation = "identity", lscale = "loge",
            elocation = list(), escale = list(), iscale = NULL,
            parallelLocation = FALSE, digt = 2, eq.scale = TRUE,
            intparloc = FALSE, imethod = 1, zero =  -2)
```

Arguments

skewpar	Numeric vectors with $0 < skewpar < 1$. Most users will only specify $skewpar$ since the estimated location parameter corresponds to the pth regression quantile/expectile, which is easier to understand. See below for details.
llocation, lscale	Character. Parameter link functions for location parameter μ, scale parameter σ.
elocation, escale	List. Extra argument for each of the links. See earg in Links for general information.

iscale	Optional initial values. If given, it must be numeric and values are recycled to the appropriate length. The default is to choose the value internally.
parallelLocation, intparloc	Logical. Should the quantiles be parallel on the transformed scale (argument llocation)? Assigning this argument to TRUE circumvents the seriously embarrassing quantile crossing problem. The argument intparloc applies to intercept term; the argument parallelLocation applies to other terms.
digt	Passed into Round as the digits argument for the tau values; used cosmetically for labelling.
eq.scale	Logical. Should the scale parameters be equal? It is advised to keep eq.scale=TRUE unchanged because it does not make sense to have different values for each skewpar value.
imethod	Initialization method. Either the value 1, 2, 3 or 4.
zero	See CommonVGAMffArguments for more information. Where possible, the default is to model all the σ and $skewpar$ as an intercept-only term.

Details

These **twopDist** family functions implement one variant of two-piece normal distribution (TPNDL) suitable for quantile/expectile regression. Its density function is

$$f(y;\mu,\sigma,p) = \frac{1}{\sigma\sqrt{2\pi}} \begin{cases} \exp\left(-\frac{(y-\mu)^2}{8\sigma^2 p^2}\right) & y < \mu \\ \exp\left(-\frac{(y-\mu)^2}{8\sigma(1-p)\sqrt{2\pi}}\right) & y \geq \mu. \end{cases}$$

Here, the ranges are for all real y and μ, positive σ and positive p.

The enumeration of the linear/additive predictors used here is to first have all the location parameters, followed by all the scale parameters.

It is known that the maximum likelihood estimate of the location parameter μ corresponds to the regression quantile/ expectile estimate of the classical quantile regression approach. An important property of the TPNDL is that $P(Y \leq \mu) = p$.

Thus twopnormlap() may be used as an alternative to rq in the **quantreg** package.

In general, the response must be a vector or a 1-column matrix.

Value

An object of class "vglmff" (see vglmff-class). The object is used by modelling functions such as vglm and vgam

In the extra slot of the fitted object are some list components which are useful, e.g., the sample proportion of values which are less than the fitted quantile curves.

Note

The **VGAM** family functions use Fisher scoring. Convergence may be slow and half-stepping is usual (although one can use trace = TRUE to see which is the best model and then use maxit to fit that model).

Author(s)

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References

Arash Ardalan, S. M. Sadooghi-Alvandi and A.N. Nematollahi (2012), The Two-Piece Normal-Laplace Distribution, 35 pages (Comm. in Statist.: Theory & Methods. Accepted).

See Also

dtwopnormlap, lms.bcn.

Examples

```
# Example 1: quantile regression with smoothing splines

# (1) Preprocessing the data
data(mmt, package = "VGAM")
melb = data.frame(today     = tail(mmt, -1),
                  yesterday = head(mmt, -1))

# Sort by yesterday's temperature:
ooo = with(melb, order(yesterday))
melb = melb[ooo,]
head(melb)

# (2) Scatter plot
## Not run:
plot(today ~ yesterday, data = melb, las = 1,
     xlab = "Yesterday's Max Temperature",
     ylab = "Today's Max Temperature",
     main = "Melbourne Temperature Data",
     pch = 0, cex = 0.25, col = "blue", xlim = c(0, 50))
abline(a = 0, b = 1, lty = "dashed")

## End(Not run)
# (3) A preliminary fit
myskew = seq(0.10, 0.90, by = 0.1) # A vector!!
fit = vgam(today ~  s(yesterday, df = 4), data = melb,
           trace = TRUE,
           fam = twopnormlap(myskew))

fit@extra # Gives some info
coef(fit, matrix = TRUE)

# (4) The regression curves
## Not run:
with(melb, matplot(yesterday, fitted(fit), type = "l",
                   lty = 1:ncol(fitted(fit)),
                   lwd = 3,
                   add = TRUE, col = 1:ncol(fitted(fit))))

text(48, tail(fitted(fit), 1), paste(myskew * 100, "%"))

## End(Not run)
```

Index