

Package ‘lqmix’

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Type Package

Title Linear Quantile Mixture Models

Description Estimate linear quantile mixtures based on discrete, Time-Constant (TC) and/or Time-Varying (TV), random coefficients.

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Author Maria Francesca Marino [aut, cre],
Marco Alfo' [aut],
Nicola Salvati [aut],
Maria Giovanna Ranalli [aut]

Maintainer Maria Francesca Marino <mariafrancesca.marino@unifi.it>

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cd4	<i>CD4 Data</i>
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Description

The cd4 data frame is made by a total of 2376 rows and 8 columns providing information on CD4 cell counts of 369 subjects followed for a maximum of 12 measurement occasions.

Usage

```
data(cd4)
```

Format

A data frame with 2376 observations on the following 8 variables:

```

sbj.id subject id
time.id time id
count CD4 count
lcount log(CD4 count + 1)
time years since seroconversion
age age (yrs) centered around 30
packs packs of cigarettes per day
partners number of sexual partners
drugs recreational drug use indicator
cesd depression score

```

Details

Multi-center AIDS Cohort Study providing a total of 2376 CD4+ cell counts of 369 HIV-infected men covering a period of approximately eight and half years. The number of measurements for each individual varies from 1 to 12. The CD4+ cell data are highly unbalanced.

References

Zeger, Scott L., and Peter J. Diggle. "Semiparametric models for longitudinal data with application to CD4 cell numbers in HIV seroconverters." *Biometrics* (1994): 689-699.

dal	<i>Density of the Asymmetric Laplace Distribution</i>
-----	---

Description

Compute the density for the asymmetric Laplace distribution

Usage

```
dal(y, mu = 0, sigma = 1, qtl = 0.5, log = FALSE)
```

Arguments

y	vector of quantiles
mu	location parameter
sigma	scale parameter
qtl	skewness parameter
log	logical; if TRUE, probabilities are log-transformed

Value

Return the density for the asymmetric Laplace distribution

lqmixTC	<i>Linear Quantile Mixture with Time-Constant (TC) Random Coefficients</i>
---------	--

Description

Estimate a finite mixture of linear quantile regression models with Time-Constant (TC), discrete, random coefficients.

Usage

```
lqmixTC(formula, randomTC, time, G, data, qtl = 0.5, eps = 10^-5,
  maxit = 1000, se = TRUE, R = 50, start = 0, parInit = list(betaf =
  NULL, betarTC = NULL, pg = NULL, scale = NULL), verbose = TRUE, ...)
```

Arguments

formula	an object of class formula of the form $y \sim x_1 + x_2 + \dots + x_p$ for fixed coefficients
randomTC	a one-sided formula of the form $\sim z_1 + z_2 + \dots + z_r \mid \text{group}$. z_1, \dots, z_r denote the variables associated to the TC random coefficients (1 for the intercept), while group is the indicator for the grouping factor, i.e. the factor identifying the unit longitudinal measurements refer to
time	a string indicating the time variable
G	number of mixture components defining the TC random coefficients
data	a data frame containing the variables named in formula, randomTC, and time
qtl	quantile to be estimated
eps	tolerance level for (relative) convergence of the EM algorithm
maxit	maximum number of iterations for the EM algorithm
se	standard error computation
R	number of bootstrap samples for computing standard errors
start	type of starting values (0 = deterministic, 1 = random, 2 = initial values in input)
parInit	list of initial model parameters when start = 2
verbose	if set to FALSE, no printed output is given during the function execution
...	further arguments to be passed to of from methods

Details

The function computes ML estimates for the parameters of a linear quantile mixture model, based on TC random coefficients. That is, a linear quantile regression model based on a finite mixture specification. Estimates are derived by maximizing the (log-)likelihood of a Laplace regression where the location parameter is modeled as a function of fixed and TC random coefficients, as proposed by Alfo' et. al (2017).

The function requires data in long-format and two additional columns indicating the unit identifier and the time occasion. Two formulas specify the model, namely formula and formulaTC: formula is associated to fixed coefficients; formulaTC is associated to TC random coefficients.

The function admits the presence of missing data, both in terms of drop-outs (monotone missing data) and intermittent missing, under a missing-at-random assumption.

If se=TRUE, standard errors based on a block bootstrap procedure are computed.

Value

Return an object of class lqmix. This is a list containing the following elements:

betaf	a vector containing fixed regression coefficients
betarTC	a matrix containing the TC random coefficients
pg	the prior probabilities of the finite mixture associated to TC random coefficients
scale	the scale parameter
sigma.e	the standard deviation of error terms

lk	the log-likelihood
npar	the total number of model parameters
aic	the AIC value
bic	the BIC value
qtl	the estimated quantile
G	the number of mixture components
nsbjs	the number of subjects
nobs	the total number of observations
se.betaf	the standard errors for fixed regression coefficients
se.betarTC	the standard errors for TC random coefficients
se.pg	the standard errors for prior probabilities of the finite mixture associated to TC random coefficients
se.scale	the standard error for the scale parameter
miss	the missingness type
model	the estimated model
call	the matched call

References

- Alfo' M, Salvati N, Ranalli MG (2017). "Finite Mixtures of Quantiles and M-quantile models." *Statistics and Computing*, **27**, 547-570.
- Aitkin M (1996). "A general maximum likelihood analysis of overdispersion in generalized linear models." *Statistics and Computing*, **6**, 251-262.
- Aitkin M (1999). "A general maximum likelihood analysis of variance components in generalized linear models." *Biometrics*, **55**, 117-128.

Examples

```
outTC = lqmixTC(formula=meas~trt+time+trt:time,randomTC=~1|id,
               time="time",G=2,data=pain,se=TRUE,R=10)
```

lqmixTCTV	<i>Linear Quantile Mixture with Time-Constant (TC) and Time-Varying (TV) Random Coefficients</i>
-----------	--

Description

Estimate a finite mixture of linear quantile regression models with both Time-Constant (TC) and Time-Varying (TV), discrete, random coefficients.

Usage

```
lqmixTCTV(formula, randomTC, randomTV, time, m, G, data, qtl = 0.5,
  eps = 10^-5, maxit = 1000, se = TRUE, R = 50, start = 0,
  parInit = list(betaf = NULL, betarTC = NULL, betarTV = NULL, pg = NULL,
  delta = NULL, Gamma = NULL, scale = NULL), verbose = TRUE, ...)
```

Arguments

formula	an object of class formula of the form $y \sim x_1 + x_2 + \dots + x_p$ for fixed coefficients
randomTC	a one-sided formula of the form $\sim z_1 + z_2 + \dots + z_r \mid \text{group}$. z_1, \dots, z_r denote the variables associated to TC random coefficients (1 for the intercept), while group is the indicator for the grouping factor, i.e. the factor identifying the unit longitudinal measurements refer to
randomTV	a one-sided formula of the form $\sim w_1 + w_2 + \dots + w_l \mid \text{group}$. w_1, \dots, w_l denote the variables associated to TV random coefficients (1 for the intercept), while group is the indicator for the grouping factor, i.e. the factor identifying the unit longitudinal measurements refer to. Only TC variables are allowed
time	a string indicating the time variable
m	number of hidden states associated the TV random coefficients
G	number of mixture components associated the TC random coefficients
data	a data frame containing the variables named in formula, randomTC, randomTV, and time
qtl	quantile to be estimated
eps	tolerance level for (relative) convergence of the EM algorithm
maxit	maximum number of iterations for the EM algorithm
se	standard error computation
R	number of bootstrap samples for computing standard errors
start	type of starting values (0 = deterministic, 1 = random, 2 = initial values in input)
parInit	list of initial model parameters when start=2
verbose	if set to FALSE, no printed output is given during the function execution
...	further arguments to be passed to of from methods

Details

The function computes ML estimates for the parameters of a linear quantile mixture model, based on TC and TV random coefficients. That is, a linear quantile regression model based on a mixed hidden Markov specification. Estimates are derived by maximizing the (log-)likelihood of a Laplace regression where the location parameter is modeled as a function of fixed, TC, and TV random coefficients, as proposed by Marino et. al (2018).

The function requires data in long-format and two additional columns indicating the unit identifier and the time occasion. Three formulas specify the model, namely formula, formulaTC, and formulaTV: formula is associated to fixed coefficients; formulaTC is associated to TC random coefficients; formulaTV is associated to TV random coefficients. In this latter, only TC variables are allowed.

The function admits the presence of missing data, both in terms of drop-outs (monotone missing data) and intermittent missing, under a missing-at-random assumption. Note that, due to the presence of TV random coefficients, intermittent missingness may cause biased inference.

Value

Return an object of `class` `lqmix`. This is a list containing the following elements:

<code>betaf</code>	a vector containing fixed regression coefficients
<code>betarTC</code>	a matrix containing the TC random coefficients
<code>betarTV</code>	a matrix containing the TV random coefficients
<code>pg</code>	the prior probabilities of the finite mixture associated to TC random coefficients
<code>delta</code>	the initial probability vector of the hidden Markov chain associated to TV random coefficients
<code>Gamma</code>	the transition probability matrix of the hidden Markov chain associated to TV random coefficients
<code>scale</code>	the scale parameter
<code>sigma.e</code>	the standard deviation of error terms
<code>lk</code>	the log-likelihood
<code>npar</code>	the total number of model parameters
<code>aic</code>	the AIC value
<code>bic</code>	the BIC value
<code>qtl</code>	the estimated quantile
<code>m</code>	the number of hidden states
<code>G</code>	the number of mixture components
<code>nsbj</code>	the number of subjects
<code>nobs</code>	the total number of observations
<code>se.betaf</code>	the standard errors for fixed regression coefficients
<code>se.betarTC</code>	the standard errors for TC random coefficients
<code>se.betarTV</code>	standard errors for TV random coefficients
<code>se.Init</code>	the standard errors for the initial probabilities of the hidden Markov chain associated to TV random coefficients
<code>se.Trans</code>	the standard errors for the transition probabilities of the hidden Markov chain associated to TV random coefficients
<code>se.Mprob</code>	the standard errors for the prior probabilities of the finite mixture associated to TC random coefficients
<code>se.scale</code>	the standard error for the scale parameter
<code>miss</code>	the missingness type
<code>model</code>	the estimated model
<code>call</code>	the matched call

References

Marino MF, Tzavidis N, Alfo' M (2018). "Mixed hidden Markov quantile regression models for longitudinal data with possibly incomplete sequences." *Statistical Methods in Medical Research*, **27**, 2231-2246.

Altman RJ (2007). "Mixed hidden Markov models: an extension of the hidden Markov model to the longitudinal data setting." *Journal of the American Statistical Association*, **102**, 201–210.

Maruotti A (2011). "Mixed Hidden Markov Models for Longitudinal Data: An Overview." *International Statistical Review*, **79**. ISSN 1751-5823.

Examples

```
outTCTV = lqmixTCTV(formula=meas~trt+time+trt:time,randomTC=~time|id,
                    randomTV=~1|id,time="time",m=2,G=2,data=pain,R=10)
```

lqmixTV

Linear Quantile Mixture with Time-Varying (TV) Random Coefficients

Description

Estimate a finite mixture of linear quantile regression models with Time-Varying (TV), discrete, random coefficients

Usage

```
lqmixTV(formula, randomTV, time, m, data, qtl = 0.5, eps = 10^-5,
        maxit = 1000, se = TRUE, R = 50, start = 0, parInit = list(betar =
        NULL, betarTV = NULL, delta = NULL, Gamma = NULL, scale = NULL),
        verbose = TRUE, ...)
```

Arguments

formula	an object of class formula of the form $y \sim x_1 + x_2 + \dots + x_p$ for fixed coefficients.
randomTV	a one-sided formula of the form $\sim w_1 + w_2 + \dots + w_v \mid \text{group}$. w_1, \dots, w_v denote the variables associated to the TV random coefficients (1 for the intercept), while group is the indicator for the grouping factor, i.e. the factor identifying the unit longitudinal measurements refer to. Only TC variables are allowed.
time	a string indicating the time variable.
m	number of hidden states associated to the TV random coefficients
data	a data frame containing the variables named in formula, randomTV, and time
qtl	quantile to be estimated
eps	tolerance level for (relative) convergence of the EM algorithm
maxit	maximum number of iterations for the EM algorithm
se	standard error computation
R	number of bootstrap samples for computing standard errors

start	type of starting values (0 = deterministic, 1 = random, 2 = initial values in input)
parInit	list of initial model parameters when start=2
verbose	if set to FALSE, no printed output is given during the function execution
...	further arguments to be passed to of from methods

Details

The function computes ML estimates for the parameters of a linear quantile mixture model, based on TV random coefficients. That is, a linear quantile regression model based on a hidden Markov specification. Estimates are derived by maximizing the (log-)likelihood of a Laplace regression where the location parameter is modeled as a function of fixed and TV random coefficients, as proposed by Farcomeni (2012). The function requires data in long-format and two additional columns indicating the unit identifier and the time occasion. Two formulas specify the model, namely `formula`, and `formulaTV`: `formula` is associated to fixed coefficients; `formulaTC` is associated to TV random coefficients. In this latter, only TC variables are allowed.

The function admits the presence of missing data, both in terms of drop-outs (monotone missing data) and intermittent missing, under a missing-at-random assumption. Note that, due to the presence of TV random coefficients, intermittent missingness may cause biased inference.

If `se=TRUE`, standard errors based on a block bootstrap procedure are computed.

Value

Return an object of `class` `lqmix`. This is a list containing the following elements:

<code>betaf</code>	a vector containing fixed regression coefficients
<code>betarTV</code>	a matrix containing the TV random coefficients
<code>Init</code>	the initial probability vector of the the hidden Markov chain associated to TV random coefficients
<code>Trans</code>	the transition probability matrix of the hidden Markov chain associated to TV random coefficients
<code>scale</code>	the scale parameter
<code>sigma.e</code>	the standard deviation of error terms
<code>lk</code>	the log-likelihood
<code>npar</code>	the total number of model parameters
<code>aic</code>	the AIC value
<code>bic</code>	the BIC value
<code>qt1</code>	the estimated quantile
<code>nsbj</code>	the number of subjects
<code>nobs</code>	the total number of observations
<code>se.betaf</code>	the standard errors for fixed regression coefficients
<code>se.betarTV</code>	the standard errors for TV random coefficients
<code>se.scale</code>	the standard error for the scale parameter
<code>miss</code>	the missingness type
<code>model</code>	the estimated model
<code>call</code>	the matched call

References

- Farcomeni A (2012). “Quantile regression for longitudinal data based on latent Markov subject-specific parameters.” *Statistics and Computing*, **22**.
- Bartolucci F, Farcomeni A, Pennoni F (2012). *Latent Markov models for longitudinal data*. Taylor & Francis.
- Zucchini W, MacDonald IL, Langrock R (2017). *Hidden Markov models for time series*, Monographs on Statistics and Applied Probability. Chapman and Hall/CRC.

Examples

```
outTV = lqmixTV(formula=meas~trt+time+trt:time,randomTV=~1|id,
               time="time",m=2,data=pain,R=10)
```

lqr *Linear Quantile Regression*

Description

Estimate a linear quantile regression model with no random coefficients

Usage

```
lqr(formula, data, qtl = 0.5, se = TRUE, R = 50, verbose = TRUE, ...)
```

Arguments

formula	an object of class formula of the form $y \sim x_1 + x_2 + \dots + x_p$ for fixed coefficients
data	a data frame containing the variables named in formula and time
qtl	quantile to be estimated
se	standard error computation
R	number of bootstrap sample for computing standard errors
verbose	if set to FALSE, no printed output is given during the function execution
...	further arguments to be passed to of from methods

Details

The function computes ML estimates for the parameters of a linear quantile regression model for independent observations. Estimates are derived by maximizing the (log-)likelihood of a Laplace regression where the location parameter is modeled as a function of fixed coefficients only.

If se=TRUE, standard errors based on a bootstrap procedure are computed.

Value

Return an object of `class` `lqr`. This is a list containing the following elements:

<code>betaf</code>	a vector containing fixed regression coefficients
<code>scale</code>	the scale parameter
<code>sigma.e</code>	the standard deviation of error terms
<code>lk</code>	the log-likelihood
<code>npar</code>	the total number of model parameters
<code>aic</code>	the AIC value
<code>bic</code>	the BIC value
<code>qtl</code>	the estimated quantile
<code>nobs</code>	the total number of observations
<code>se.betaf</code>	the standard errors for fixed regression coefficients
<code>se.scale</code>	the standard error for the scale parameter
<code>model</code>	the estimated model
<code>call</code>	the matched call

References

Geraci M, Bottai M (2007). "Quantile regression for longitudinal data using the asymmetric Laplace distribution." *Biostatistics*, **8**, 140-54.

Examples

```
out0 = lqr(formula=meas~trt+time+trt:time,data=pain,se=TRUE,R=10)
```

<code>pain</code>	<i>Pain Data</i>
-------------------	------------------

Description

The pain data frame is made by a total of 357 rows and 4 columns providing information on pain of 83 women in labor followed for a maximum of 6 measurement occasions.

Usage

```
data(pain)
```

Format

A data frame with 357 observations on the following 5 variables:

`id` woman id
`meas` a numeric vector of self-reported pain scores on a 100mm line
`trt` a dummy variable with values 1 for subjects who received a pain medication and 0 for subjects who received a placebo
`time` a numeric vector of times (minutes since randomization) at which pain was measured

Details

The data set consists of repeated measurements of self-reported pain on $n = 83$ women. 43 women were randomly assigned to a pain medication group and 40 to a placebo group. The response was measured every 30 minutes on a 100-mm line: 0 means no pain and 100 means extreme pain. The number of measurements for each woman varies from 1 to 6. Data are severely skewed, and the skewness changes magnitude, and even sign, over time.

References

Davis, Charles S. "Semi-parametric and non-parametric methods for the analysis of repeated measurements with applications to clinical trials." *Statistics in medicine* 10.12 (1991): 1959-1980.

print.lqmix	<i>Print an lqmix Object</i>
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Description

Print an object of `class` lqmix

Usage

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

Arguments

x	an lqmix object
digits	a non-null value for digits specifies the minimum number of significant digits to be printed
...	not used

Value

Return an lqmix object

```
print.lqr          Print an lqr Object
```

Description

Print an object of `class` lqr

Usage

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

Arguments

x	an lqr object
digits	a non-null value for digits specifies the minimum number of significant digits to be printed
...	not used

Value

Return an lqr object

```
print.search_lqmix  Print a search_lqmix Object
```

Description

Print an object of `class` search_lqmix

Usage

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

Arguments

x	a search_lqmix object
digits	a non-null value for digits specifies the minimum number of significant digits to be printed
...	not used

Value

Return a search_lqmix object

```
print.summary.lqmix    Print the Summary of an lqmix Object
```

Description

Print the summary of an object of `class` `lqmix`

Usage

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

Arguments

<code>x</code>	a summary of an <code>lqmix</code> object
<code>digits</code>	a non-null value for <code>digits</code> specifies the minimum number of significant digits to be printed
<code>...</code>	not used

Value

Return a summary of an `lqmix` object

```
print.summary.lqr    Print the Summary of an lqr Object
```

Description

Print the summary of an an object of `class` `lqr`

Usage

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

Arguments

<code>x</code>	a summary of an <code>lqr</code> object
<code>digits</code>	a non-null value for <code>digits</code> specifies the minimum number of significant digits to be printed
<code>...</code>	not used

Value

Return a summary of an `lqr` object

search_lqmix

*Search the Global Maximum of a Linear Quantile Mixture***Description**

Search the global maximum of the log-likelihood function for a finite mixture of linear quantile regression models with TC and/or TV, discrete, random coefficients, for varying number of components and/or states

Usage

```
search_lqmix(formula, randomTC = NULL, randomTV = NULL, time, Gv = NULL,
             mv = NULL, data, method = "bic", nran = 0, qtl = 0.5, eps = 10^-5,
             maxit = 1000, se = TRUE, R = 50, verbose = TRUE)
```

Arguments

formula	an object of class formula: a symbolic description of the model to be fitted
randomTC	a one-sided formula of the form $\sim z_1 + z_2 + \dots + z_r \mid \text{group}$. z_1, \dots, z_r denote the variables associated to TC random coefficients (1 for the intercept), while group is the indicator for the grouping factor, i.e. the factor identifying the unit longitudinal measurements refer to
randomTV	a one-sided formula of the form $\sim w_1 + w_2 + \dots + w_l \mid \text{group}$. w_1, \dots, w_l denote the variables associated to TV random coefficients (1 for the intercept), while group is the indicator for the grouping factor, i.e. the factor identifying the unit longitudinal measurements refer to. Only TC variables are allowed.
time	a string indicating the time variable
Gv	vector of possible number of mixture components associated to TC random coefficients
mv	vector of possible number of states associated to the TV random coefficients
data	a data frame containing the variables named in formula, randomTC and/or randomTV, and time
method	method to use for selecting the optimal model. Possible values are "lk", "aic", or "bic"
nran	number of repetitions of each random initialization
qtl	quantile to be estimated
eps	tolerance level for (relative) convergence of the EM algorithm
maxit	maximum number of iterations for the EM algorithm
se	standard error computation for the optimal model
R	number of bootstrap samples for computing standard errors
verbose	if set to FALSE, no printed output is given during the function execution

Details

The function allows to identify the optimal model specification in terms of number of mixture components and/or hidden states associated to TC and/or TV random coefficients, respectively. This is done by considering a multi-start strategy based on both deterministic and random starting points. The number of random tries is proportional to the number of mixture components and/or hidden states associated to the random coefficients in the model.

If method="lk" the optimal model selected by the function is that providing the highest log-likelihood value; if method="AIC" (method="BIC", respectively), the optimal model selected by the function is that providing the lowest AIC (BIC, respectively) value.

If se=TRUE, standard errors based on a block bootstrap procedure are computed for the identified optimal model.

Value

Return a list with the following elements:

optimal	the identified optimal model
allmodels	the output of each estimated model
lkv	the vector of likelihood values for each estimated model
aicv	the vector of AIC values for each estimated model
bicv	the vector of BIC values for each estimated model
qtl	the estimated quantile
mv	the vector of possible number of states associated to the TV random coefficients (if present)
Gv	the vector of possible number of mixture components associated to the TC random coefficients (if present)
call	the matched call

Examples

```
sTC = search_lqmix(formula=meas~trt+time+trt:time,
                  randomTC=~1|id,time="time",Gv=1:3,method="bic",data=pain,se=FALSE)
```

```
sTV = search_lqmix(formula=meas~trt+time+trt:time,
                  randomTV=~1|id,time="time",mv=1:3,method="bic",data=pain,se=FALSE)
```

```
sTCTV = search_lqmix(formula=meas~trt+time+trt:time,
                    randomTC=~time|id,randomTV=~1|id,time="time",mv=1:3,Gv=1:3,method="bic",data=pain,se=FALSE)
```

summary.lqmix *Summary of an lqmix Object*

Description

Summary method for the class lqmix.

Usage

```
## S3 method for class 'lqmix'
summary(object, ...)
```

Arguments

object	an lqmix object
...	not used

Value

Return an object of `class` `summary.lqmix`. This is a list of summary statistics for the fitted linear quantile mixture model given in `object`, with the following elements:

fix	a matrix with estimates, standard errors, Z statistics, and pvalues for the fixed regression coefficients
ranTC	a matrix with estimates, standard errors, Z statistics, and pvalues for the TC random coefficients (if present)
ranTV	a matrix with estimates, standard errors, Z statistics, and pvalues for the TV random coefficients (if present)
pg	a matrix with estimates and standard errors for the prior probabilities of the finite mixture associated to TC random coefficients (if present)
delta	a matrix with estimates and standard errors for the initial probabilities of the hidden Markov chain associated to TV random coefficients (if present)
Gamma	a matrix with estimates and standard errors for the transition probabilities of the hidden Markov chain associated to TV random coefficients (if present)
scale	the scale parameter
sigma.e	the standard deviation of error terms
lk	the log-likelihood
npar	the total number of model parameters
aic	the AIC value
bic	the BIC value
qtl	the estimated quantile
G	the number of mixture components (if TC random coefficients are present)
m	the number of hidden states (if TV random coefficients are present)

nsbj	the number of subjects
nobs	the total number of observations
miss	the missingness type
model	the estimated model
call	the matched call

summary.lqr	<i>Summary of an lqr object</i>
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Description

Summary method for the class lqr

Usage

```
## S3 method for class 'lqr'
summary(object, ...)
```

Arguments

object	an lqr object
...	not used

Value

Return an object of `class` `summary.lqr`. This is a list of summary statistics for the fitted linear quantile regression model given in `object`, with the following elements:

fix	a matrix with estimates, standard errors, Z statistics, and pvalues for the regression coefficients
scale	the scale parameter
sigma.e	the standard deviation of error terms
lk	the log-likelihood
npar	the total number of model parameters
aic	the AIC value
bic	the BIC value
qtl	the estimated quantile
nobs	the total number of observations
model	the estimated model
call	the matched call

`varAL`*Variance of Asymmetric Laplace random variables*

Description

Compute the variance for the asymmetric Laplace distribution

Usage

```
varAL(sigma, qtl)
```

Arguments

<code>sigma</code>	scale parameter
<code>qtl</code>	skewness parameter

Value

Return the variance of Asymmetric Laplace random variables for given scale (`sigma`) and skewness (`qtl`) parameters

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