Package 'truncSP'

October 14, 2022

Type Package

Title Semi-parametric estimators of truncated regression models

Version 1.2.2

Date 2014-05-05

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Description Semi-parametric estimation of truncated linear regression models

License GPL (>= 2)

LazyLoad yes

Depends R(>= 2.10), stats, methods, truncreg, boot

NeedsCompilation no

Repository CRAN

Date/Publication 2014-05-05 11:43:44

R topics documented:

truncSP-package *Estimators of semi-parametric truncated regression models*

Description

Functions for estimation of semi-parametric linear regression models with truncated response variables (fixed truncation point). Estimation using the Symmetrically Trimmed Least Squares (STLS) estimator (Powell 1986), Quadratic Mode (QME) estimator (Lee 1993) and Left Truncated (LT) estimator (Karlsson 2006).

Details

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Version:	1.2.2
Date:	2014-05-05
License:	GPL (>=2)
LazyLoad:	yes
Depends:	R(>= 2.10), methods, truncreg, boot

These semi-parametric estimators provide an alternative to maximum likelihood estimators, which are sensitive to distributional misspecification (Davidson and MacKinnon, 1993, p 536). All three estimators use trimming of the conditional density of the error terms. STLS assumes symmetrically distributed error terms, while QME and LT have been shown to be consistent for estimation of the slope parameters under asymmetrically distributed errors as well (Laitila 2001 and Karlsson 2006). The functions in the package (`qme`, `lt` and `stls`), all use `optim` to maximize or minimize objective functions wrt the vector of regression coefficients in order to find estimates (Karlsson and Lindmark, 2014). As the covariance matrices of the estimators depend on the density of the error distribution, the estimation of these is complicated and bootstrap (as described in Karlsson 2004 and Karlsson and Lindmark 2014) is used in all three functions.

Author(s)

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References

Davidson, R., MacKinnon, J. G. (1993) *Estimation and Inference in Econometrics*, Oxford University Press, USA

Karlsson, M. (2004) Finite sample properties of the QME, *Communications in Statistics - Simulation and Computation*, **5**, pp 567–583

Karlsson, M. (2006) Estimators of regression parameters for truncated and censored data, *Metrika*, **63**, pp 329–341

Karlsson, M., Lindmark, A. (2014) truncSP: An R Package for Estimation of Semi-Parametric Truncated Linear Regression Models, *Journal of Statistical Software*, **57(14)**, pp 1–19, http://www.jstatsoft.org/v57/i14/

Laitila, T. (2001) Properties of the QME under asymmetrically distributed disturbances, *Statistics & Probability Letters*, **52**, pp 347–352

Lee, M. (1993) Quadratic mode regression, *Journal of Econometrics*, **57**, pp 1-19

Lee, M., Kim, H. (1998) Semiparametric econometric estimators for a truncated regression model: a review with an extension, *Statistica Neerlandica*, **52(2)**, pp 200–225

Powell, J. (1986) Symmetrically Trimmed Least Squares Estimation for Tobit Models, *Econometrika*, **54(6)**, pp 1435–1460

See Also

truncreg, function for estimating models with truncated response variables by maximum likelihood assuming Gaussian errors

Examples

```
 ##Simulate a data.frame (model with asymmetrically distributed errors)
n <- 10000
x1 <- runif(n,0,10)
x2 <- runif(n,0,10)
x3 <- runif(n,-5,5)
eps <- rexp(n,0.2)- 5
y <- 2-2*x1+x2+2*x3+eps
d <- data.frame(y=y,x1=x1,x2=x2,x3=x3)

##Use a truncated subsample
dtrunc <- subset(d, y>0)

##Use qme or lt to consistently estimate the slope parameters
qme(y~x1+x2+x3, dtrunc, point=0, direction="left", cval="ols", const=1,
   beta="ols", covar=FALSE)
lt(y~x1+x2+x3, dtrunc, point=0, direction="left", clower="ols", const=1,
   cupper=2, beta="ols", covar=FALSE)

##Simulate a data.frame (symmetrically distributed errors)
n <- 10000
x1 <- runif(n,0,10)
x2 <- runif(n,0,10)
x3 <- runif(n,-5,5)
y <- 1-2*x1+x2+2*x3+rnorm(n,0,2)
d <- data.frame(y=y,x1=x1,x2=x2,x3=x3)
```

```
##Use a truncated subsample
dtrunc <- subset(d, y>0)

##Use stls to estimate the model
stls(y~x1+x2+x3, dtrunc, point=0, direction="left", beta="ols", covar=FALSE)
```

`lt` *Estimation of truncated regression models using the Left Truncated (LT) estimator*

Description

Estimates linear regression models with truncated response variables (fixed truncation point), using the LT estimator (Karlsson 2006).

Usage

```
lt(formula, data, point = 0, direction = "left", clower = "ml", const = 1, cupper = 2,
   beta = "ml", covar = FALSE, na.action, ...)
## S4 method for signature 'lt'
print(x, digits = max(3, getOption("digits") - 3), ...)
## S4 method for signature 'lt'
summary(object, level=0.95, ...)
## S4 method for signature 'summary.lt'
print(x, digits= max(3, getOption("digits") - 3), ...)
## S4 method for signature 'lt'
coef(object,...)
## S4 method for signature 'lt'
vcov(object,...)
## S4 method for signature 'lt'
residuals(object,...)
## S4 method for signature 'lt'
fitted(object,...)
```

Arguments

`x, object`	an object of class `"lt"`
`formula`	a symbolic description of the model to be estimated
`data`	an optional data frame
`point`	the value of truncation (the default is 0)
`direction`	the direction of truncation, either `"left"` (the default) or `"right"`
`clower`	the lower threshold value to be used when trimming the conditional density of the errors from below. The default is `"ml"` meaning that the residual standard deviation from fitting a maximum likelihood model for truncated regression, using `truncreg`, is used. Method `"ols"` uses the estimated residual standard deviation from a linear model fitted by `lm`. It is also possible to manually supply the threshold value by setting `clower` to be equal to a number or numeric vector of length one.

`const` a number that can be used to alter the size of the lower threshold. `const=0.5` would give a lower threshold value that is half the original size. The default value is 1.

`cupper` number indicating what upper threshold to use when trimming the conditional density of the errors from above. The number is used to multiply the lower threshold value, i.e. if `cupper=2` (the default value) the upper threshold value is two times larger than the lower threshold value.

`beta` the method of determining the starting values of the regression coefficients (See Details for more information):

- The default method is `"ml"`, meaning that the estimated regression coefficients from fitting a maximum likelihood model for truncated regression, assuming Gaussian errors, are used. The maximum likelihood model is fitted using `truncreg`.
- Method `"ols"` means that the estimated regression coefficients from fitting a linear model with `lm`.
- The third option is to manually provide starting values as either a vector, column matrix or row matrix.

`covar` logical. Indicates whether or not the covariance matrix should be estimated. If `TRUE` the covariance matrix is estimated using bootstrap. The default number of replicates is 2000 but this can be adjusted (see argument `...`). However, since the bootstrap procedure is time-consuming the default is `covar=FALSE`.

`na.action` a function which indicates what should happen when the data contain `NA`s.

`digits` the number of digits to be printed

`level` the desired level of confidence, for confidence intervals provided by `summary.lt`. A number between 0 and 1. The default value is `0.95`.

`...` additional arguments. For `lt` the number of bootstrap replicates can be adjusted by setting `R=`the desired number of replicates. Also the `control` argument of `optim` can be set by `control=list()` (see Details for more information).

Details

Minimizes the objective function described in Karlsson (2006) wrt the vector of regression coefficients, in order to find the LT estimates. The minimization is performed by `optim` using the "Nelder–Mead" method, and a maximum number of iterations of 2000. The maximum number of iterations can be adjusted by setting `control=list(maxit=...)` (for more information see the documentation for `optim`).

It is recommended to use one of the methods for generating the starting values of the regression coefficients (see argument `beta`) rather than supplying these manually, unless one is confident that one has a good idea of what these should be. This because the starting values can have a great impact on the result of the minimization.

Note that setting `cupper=1` means that the LT estimates will coincide with the estimates from the Quadratic Mode Estimator (see function `qme`). For more detailed information see Karlsson and Lindmark (2014).

Value

`lt` returns an object of class `"lt"`.

The function `summary` prints a summary of the results, including two types of confidence intervals (normal approximation and percentile method). The generic accessor functions `coef`, `fitted`, `residuals` and `vcov` extract various useful features of the value returned by `lt`

An object of class `"lt"`, a list with elements:

`coefficients`	the named vector of coefficients
`startcoef`	the starting values of the regression coefficients used by `optim`
`cvalues`	information about the thresholds used. The method and constant used and the resulting lower and upper threshold values.
`value`	the value of the objective function corresponding to `coefficients`
`counts`	number of iterations used by `optim`. See the documentation for `optim` for further details
`convergence`	from `optim`. An integer code. 0 indicates successful completion. Possible error codes are 1 indicating that the iteration limit maxit had been reached. 10 indicating degeneracy of the Nelder–Mead simplex.
`message`	from `optim`. A character string giving any additional information returned by the optimizer, or `NULL`.
`residuals`	the residuals of the model
`fitted.values`	the fitted values
`df.residual`	the residual degrees of freedom
`call`	the matched call
`covariance`	if `covar=TRUE`, the estimated covariance matrix
`R`	if `covar=TRUE`, the number of bootstrap replicates
`bootrepl`	if `covar=TRUE`, the bootstrap replicates

Author(s)

Anita Lindmark and Maria Karlsson

References

Karlsson, M. (2006) Estimators of regression parameters for truncated and censored data, *Metrika*, **63**, pp 329–341

Karlsson, M., Lindmark, A. (2014) truncSP: An R Package for Estimation of Semi-Parametric Truncated Linear Regression Models, *Journal of Statistical Software*, **57(14)**, pp 1–19, http://www.jstatsoft.org/v57/i14/

See Also

lt.fit, the function that does the actual fitting

qme, for estimation of models with truncated response variables using the QME estimator

stls, for estimation of models with truncated response variables using the STLS estimator

truncreg for estimating models with truncated response variables by maximum likelihood, assuming Gaussian errors

Examples

```
##Simulate a data.frame (model with asymmetrically distributed errors)
n <- 10000
x1 <- runif(n,0,10)
x2 <- runif(n,0,10)
x3 <- runif(n,-5,5)
eps <- rexp(n,0.2)- 5
y <- 2-2*x1+x2+2*x3+eps
d <- data.frame(y=y,x1=x1,x2=x2,x3=x3)


##Use a truncated subsample
dtrunc <- subset(d, y>0)

##Use lt to consistently estimate the slope parameters
lt(y~x1+x2+x3, dtrunc, point=0, direction="left", clower="ml", const=1,
   cupper=2, beta="ml", covar=FALSE)

##Example using data "PM10trunc"
data(PM10trunc)

ltpm10 <- lt(PM10~cars+temp+wind.speed+temp.diff+wind.dir+hour+day,
   data=PM10trunc, point=2, control=list(maxit=2500))

summary(ltpm10)
```

---

lt-class *Class "lt"*

Description

Documentation on S4 class "lt".

Objects from the Class

Objects from the class are usually obtained by a call to the function lt.

Slots

`call`: Object of class `"call"` the function call

`coefficients`: Object of class `"matrix"` the estimated coefficients from fitting a model for truncated regression using the Quadratic Mode Estimator (QME)

`startcoef`: Object of class `"matrix"` the starting coefficients used when fitting the model

`cvalues`: Object of class `"data.frame"` containing information about the thresholds used

`value`: Object of class `"numeric"` the value of the objective function corresponding to `coefficients`

`counts`: Object of class `"integer"` number of iterations until convergence

`convergence`: Object of class `"integer"` indicating whether convergence was achieved

`message`: Object of class `"character"` a character string giving any additional information returned by the optimizer

`residuals`: Object of class `"matrix"` the residuals of the model

`fitted.values`: Object of class `"matrix"` the fitted values

`df.residual`: Object of class `"integer"` the residual degrees of freedom

`covariance`: Object of class `"matrix"` the estimated covariance matrix

`bootrepl`: Object of class `"matrix"` bootstrap replicates used to estimate the covariance matrix

Methods

coef `signature(object = "lt")`: extracts the coefficients of the model fitted using `lt`

fitted `signature(object = "lt")`: extracts the fitted values of the model fitted using `lt`

print `signature(x = "lt")`: print method

residuals `signature(object = "lt")`: extracts the residuals of the model fitted using `lt`

summary `signature(object = "lt")`: summary method

vcov `signature(object = "lt")`: extracts the covariance matrix of the model fitted using `lt`

Author(s)

Anita Lindmark and Maria Karlsson

See Also

Function `lt` and class `"summary.lt"`

Examples

```
showClass("lt")
```

`lt.fit` *Function for fitting LT*

Description

Function to find LT estimates of the regression coefficients for regression models with truncated response variables. Uses `optim`. Intended to be called through `lt`, not on its own, since `lt` also transforms data into the correct form etc.

Usage

```
lt.fit(formula, mf, point, direction, bet, cl, cu, ...)
```

Arguments

`formula`	a symbolic description of the model to be estimated
`mf`	the `model.frame` containing the variables to be used when fitting the model. `lt` transforms the model frame to the correct form before calling `lt.fit`. If `lt.fit` is called on its own the model frame needs to be transformed manually.
`point`	point of truncation
`direction`	direction of truncation
`bet`	starting values to be used by `optim`. Column matrix with p rows.
`cl`	lower threshold value to be used, number or numeric vector of length 1. (See `lt`, argument `clower`, for more information).
`cu`	upper threshold value to be used, number or numeric vector of length 1. (See `lt`, argument `cupper`, for more information).
`...`	additional arguments to be passed to `optim` (see the documentation for `lt` for further details).

Value

a list with components:

`startcoef`	the starting values of the regression coefficients used by `optim`
`coefficients`	the named vector of coefficients
`counts`	number of iterations used by `optim`. See the documentation for `optim` for further details
`convergence`	from `optim`. An integer code. 0 indicates successful completion. Possible error codes are 1 indicating that the iteration limit maxit had been reached. 10 indicating degeneracy of the Nelder–Mead simplex.
`message`	from `optim`. A character string giving any additional information returned by the optimizer, or `NULL`.
`residuals`	the residuals of the model
`df.residual`	the residual degrees of freedom
`fitted.values`	the fitted values

Author(s)

Anita Lindmark and Maria Karlsson

See Also

lt

Examples

```
require(utils)
##Model frame
n <- 10000
x <- rnorm(n,0,2)
y <- 2+x+4*rnorm(n)
d <- data.frame(y=y, x=x)
dl0 <- subset(d, y>0)
mf <- model.frame(y~x, data=dl0)

##Starting values and threshold values
lmmod <- lm(data=mf)
bet <- lmmod$coef
bet <- matrix(bet)
cl <- sqrt(deviance(lmmod)/df.residual(lmmod))
cu <- 2*cl

str(lt. <- lt.fit(y~x,mf,point=0,direction="left",bet,cl,cu))
```

PM10 *Air pollution data*

Description

The data are a subsample of 500 observations from a data set that originates in a study where air pollution at a road is related to traffic volume and meteorological variables, collected by the Norwegian Public Roads Administration. The response variable consists of hourly values of the logarithm of the concentration of PM10 (particles), measured at Alnabru in Oslo, Norway, between October 2001 and August 2003. (Source: Statlib)

Usage

```
data(PM10)
```

Format

A data frame with 500 observations on the following 8 variables.

`PM10` Hourly values of the logarithm of the concentration of PM10 (particles)

`cars` The logarithm of the number of cars per hour

`temp` Temperature 2 meters above ground (degree C)

`wind.speed` Wind speed (meters/second)

`temp.diff` The temperature difference between 25 and 2 meters above ground (degree C)

`wind.dir` Wind direction (degrees between 0 and 360)

`hour` Hour of day

`day` Day number from October 1. 2001

Source

http://lib.stat.cmu.edu/, dataset PM10, submitted by Magne Aldrin on July 28, 2004

References

Aldrin, M. (2006) Improved predictions penalizing both slope and curvature in additive models, *Computational Statistics & Data Analysis*, **50**, pp 267–284

Examples

```
data(PM10)
```

`PM10trunc` *Air pollution data (Truncated)*

Description

Dataset `PM10`, truncated from the left at variable value PM10 = 2 (8 percent truncation).

Usage

```
data(PM10trunc)
```

Format

A data frame with 460 observations on the following 8 variables.

`PM10` Hourly values of the logarithm of the concentration of PM10 (particles). Left-truncated at point 2.

`cars` The logarithm of the number of cars per hour

`temp` Temperature 2 meters above ground (degree C)

`wind.speed` Wind speed (meters/second)

`temp.diff` The temperature difference between 25 and 2 meters above ground (degree C)

`wind.dir` Wind direction (degrees between 0 and 360)

`hour` Hour of day

`day` Day number from October 1. 2001

Examples

```
data(PM10trunc)
```

qme *Estimation of truncated regression models using the Quadratic Mode Estimator (QME)*

Description

Estimation of linear regression models with truncated response variables (fixed truncation point), using the Quadratic Mode Estimator (QME) (Lee 1993 and Laitila 2001)

Usage

```
qme(formula, data, point = 0, direction = "left", cval = "ml",
  const = 1, beta = "ml", covar = FALSE, na.action, ...)
## S4 method for signature 'qme'
print(x, digits = max(3, getOption("digits") - 3), ...)
## S4 method for signature 'qme'
summary(object, level=0.95, ...)
## S4 method for signature 'summary.qme'
print(x, digits = max(3, getOption("digits") - 3), ...)
## S4 method for signature 'qme'
coef(object,...)
## S4 method for signature 'qme'
vcov(object,...)
## S4 method for signature 'qme'
residuals(object,...)
## S4 method for signature 'qme'
fitted(object,...)
```

Arguments

`x, object`	an object of class `"qme"`
`formula`	a symbolic description of the model to be estimated
`data`	an optional data frame
`point`	the value of truncation (the default is 0)
`direction`	the direction of truncation, either `"left"` (the default) or `"right"`
`cval`	the threshold value to be used when trimming the conditional density of the errors. The default is `"ml"` meaning that the estimated residual standard deviation from a maximum likelihood model for truncated regression, fitted using `truncreg`, is used. Method `"ols"` uses the residual standard deviation from fitting a linear model using `lm`. It is also possible to manually supply the threshold by setting `cval` to be equal to a number or numeric vector of length one.
`const`	a number that can be used to alter the size of the threshold value. `const=0.5` would give a threshold value that is half the original size. The default value is 1.
`beta`	the method of determining the starting values of the regression coefficients (See Details for more information):

- The default method is "ml", meaning that the estimated regression coefficients from fitting a maximum likelihood model for truncated regression, assuming Gaussian errors, are used. The maximum likelihood model is fitted using truncreg.
- Method "ols" means that the estimated regression coefficients from fitting a linear model with lm are used.
- The third option is to manually provide starting values as either a vector, column matrix or row matrix.

covar — logical. Indicates whether or not the covariance matrix should be estimated. If TRUE the covariance matrix is estimated using bootstrap, as described in Karlsson (2004). The default number of replicates is 2000 but this can be adjusted (see argument ...). However, since the bootstrap procedure is time-consuming the default is covar=FALSE.

na.action — a function which indicates what should happen when the data contain NAs.

digits — the number of digits to be printed

level — the desired level of confidence, for confidence intervals provided by summary.qme. A number between 0 and 1. The default value is 0.95.

... — additional arguments. For qme the number of bootstrap replicates can be adjusted by setting R=the desired number of replicates. Also the control argument of optim can be set by control=list() (for more information on this see Details).

Details

Finds the QME estimates of the regression coefficients by maximizing the objective function described in Lee (1993) wrt the vector of regression coefficients. The maximization is performed by optim using the "Nelder–Mead" method. The maximum number of iterations is set at 2000, but this can be adjusted by setting control=list(maxit=...) (for more information see the documentation for optim).

The starting values of the regression coefficients can have a great impact on the result of the maximization. For this reason it is recommended to use one of the methods for generating these rather than supplying the values manually, unless one is confident that one has a good idea of what the starting values should be. For more detailed information see Karlsson and Lindmark (2014).

Value

qme returns an object of class "qme".

The function summary prints a summary of the results, including two types of confidence intervals (normal approximation and percentile method). The generic accessor functions coef, fitted, residuals and vcov extract various useful features of the value returned by qme

An object of class "qme", a list with elements:

coefficients — the named vector of coefficients

startcoef — the starting values of the regression coefficients used by optim

cval	information about the threshold value used. The method and constant value used and the resulting threshold value.
value	the value of the objective function corresponding to coefficients
counts	number of iterations used by optim. See the documentation for optim for further details
convergence	from optim. An integer code. 0 indicates successful completion. Possible error codes are 1 indicating that the iteration limit maxit had been reached. 10 indicating degeneracy of the Nelder–Mead simplex.
message	from optim. A character string giving any additional information returned by the optimizer, or NULL.
residuals	the residuals of the model
fitted.values	the fitted values
df.residual	the residual degrees of freedom
call	the matched call
covariance	if covar=TRUE, the estimated covariance matrix
R	if covar=TRUE, the number of bootstrap replicates
bootrepl	if covar=TRUE, the bootstrap replicates

Author(s)

Anita Lindmark and Maria Karlsson

References

Karlsson, M. (2004) Finite sample properties of the QME, *Communications in Statistics - Simulation and Computation*, **5**, pp 567–583

Karlsson, M., Lindmark, A. (2014) truncSP: An R Package for Estimation of Semi-Parametric Truncated Linear Regression Models, *Journal of Statistical Software*, **57(14)**, pp 1–19, http://www.jstatsoft.org/v57/i14/

Laitila, T. (2001) Properties of the QME under asymmetrically distributed disturbances, *Statistics & Probability Letters*, **52**, pp 347–352

Lee, M. (1993) Quadratic mode regression, *Journal of Econometrics*, **57**, pp 1-19

Lee, M. & Kim, H. (1998) Semiparametric econometric estimators for a truncated regression model: a review with an extension, *Statistica Neerlandica*, **52(2)**, pp 200–225

See Also

qme.fit, the function that does the actual fitting

lt, for estimation of models with truncated response variables using the LT estimator

stls, for estimation of models with truncated response variables using the STLS estimator

truncreg for estimating models with truncated response variables by maximum likelihood, assuming Gaussian errors

Examples

```
##Simulate a data.frame (model with asymmetrically distributed errors)
n <- 10000
x1 <- runif(n,0,10)
x2 <- runif(n,0,10)
x3 <- runif(n,-5,5)
eps <- rexp(n,0.2)- 5
y <- 2-2*x1+x2+2*x3+eps
d <- data.frame(y=y,x1=x1,x2=x2,x3=x3)

##Use a truncated subsample
dtrunc <- subset(d, y>0)

##Use qme to consistently estimate the slope parameters
qme(y~x1+x2+x3, dtrunc, point=0, direction="left", cval="ml", const=1,
   beta="ml", covar=FALSE)

##Example using data "PM10trunc"
data(PM10trunc)

qmepm10 <- qme(PM10~cars+temp+wind.speed+temp.diff+wind.dir+hour+day,
   data=PM10trunc, point=2, control=list(maxit=4500))

summary(qmepm10)
```

---

qme-class *Class "qme"*

Description

Documentation on S4 class "qme".

Objects from the Class

Objects from the class are usually obtained by a call to the function qme.

Slots

call: Object of class "call" the function call

coefficients: Object of class "matrix" the estimated coefficients from fitting a model for truncated regression using the Quadratic Mode Estimator (QME)

startcoef: Object of class "matrix" the starting coefficients used when fitting the model

`cval`: Object of class "`data.frame`" containing information about the threshold value used

`value`: Object of class "`numeric`" the value of the objective function corresponding to `coefficients`

`counts`: Object of class "`integer`" number of iterations until convergence

`convergence`: Object of class "`integer`" indicating whether convergence was achieved

`message`: Object of class "`character`" a character string giving any additional information returned by the optimizer

`residuals`: Object of class "`matrix`" the residuals of the model

`fitted.values`: Object of class "`matrix`" the fitted values

`df.residual`: Object of class "`integer`" the residual degrees of freedom

`covariance`: Object of class "`matrix`" the estimated covariance matrix

`bootrepl`: Object of class "`matrix`" bootstrap replicates used to estimate the covariance matrix

Methods

coef `signature(object = "qme")`: extracts the coefficients of the model fitted using `qme`

fitted `signature(object = "qme")`: extracts the fitted values of the model fitted using `qme`

print `signature(x = "qme")`: print method

residuals `signature(object = "qme")`: extracts the residuals of the model fitted using `qme`

summary `signature(object = "qme")`: summary method

vcov `signature(object = "qme")`: extracts the covariance matrix of the model fitted using `qme`

Author(s)

Anita Lindmark and Maria Karlsson

See Also

Function `qme` and class "`summary.qme`"

Examples

```
showClass("qme")
```

---

qme.fit *Function for fitting QME*

Description

Function to find QME estimates of the regression coefficients for regression models with truncated response variables. Uses `optim`. Intended to be called through `qme`, not on its own, since `qme` also transforms data into the correct form etc.

Usage

```
qme.fit(formula, mf, point, direction, bet, cv, ...)
```

Arguments

formula	a symbolic description of the model to be estimated
mf	the model.frame containing the variables to be used when fitting the model. qme transforms the model frame to the correct form before calling qme.fit. If qme.fit is called on its own the model frame needs to be transformed manually.
point	point of truncation
direction	direction of truncation
bet	starting values to be used by optim. Column matrix with p rows.
cv	threshold value to be used, number or numeric vector of length 1. (See qme, argument cval, for more information).
...	additional arguments to be passed to optim (see the documentation for qme for further details).

Value

a list with components:

startcoef	the starting values of the regression coefficients used by optim
coefficients	the named vector of coefficients
counts	number of iterations used by optim. See the documentation for optim for further details
convergence	from optim. An integer code. 0 indicates successful completion. Possible error codes are 1 indicating that the iteration limit maxit had been reached. 10 indicating degeneracy of the Nelder–Mead simplex.
message	from optim. A character string giving any additional information returned by the optimizer, or NULL.
residuals	the residuals of the model
df.residual	the residual degrees of freedom
fitted.values	the fitted values

Author(s)

Anita Lindmark and Maria Karlsson

See Also

qme

Examples

```
require(utils)
##Model frame
n <- 10000
x <- rnorm(n,0,2)
y <- 2+x+4*rnorm(n)
d <- data.frame(y=y, x=x)
dl0 <- subset(d, y>0)
mf <- model.frame(y~x, data=dl0)

##Starting values and threshold value
lmmod <- lm(data=mf)
bet <- lmmod$coef
bet <- matrix(bet)
cv <- sqrt(deviance(lmmod)/df.residual(lmmod))

str(qme. <- qme.fit(y~x,mf,point=0,direction="left",bet,cv))
```

`stls` *Estimation of truncated regression models using the Symmetrically Trimmed Least Squares (STLS) estimator*

Description

Function for estimation of linear regression models with truncated response variables (fixed truncation point), using the STLS estimator (Powell 1986)

Usage

```
stls(formula, data, point = 0, direction = "left", beta = "ml",
    covar = FALSE, na.action, ...)
## S4 method for signature 'stls'
print(x, digits = max(3, getOption("digits") - 3), ...)
## S4 method for signature 'stls'
summary(object, level=0.95, ...)
## S4 method for signature 'summary.stls'
print(x, digits= max(3, getOption("digits") - 3), ...)
## S4 method for signature 'stls'
coef(object,...)
## S4 method for signature 'stls'
vcov(object,...)
## S4 method for signature 'stls'
residuals(object,...)
## S4 method for signature 'stls'
fitted(object,...)
```

Arguments

x, object	an object of class "stls"
formula	a symbolic description of the model to be estimated
data	an optional data frame
point	the value of truncation (the default is 0)
direction	the direction of truncation, either "left" (the default) or "right"
beta	the method of determining the starting values of the regression coefficients (See Details for more information): • The default method is "ml", meaning that the estimated regression coefficients from fitting a maximum likelihood model for truncated regression, assuming Gaussian errors, are used. The maximum likelihood model is fitted using truncreg. • Method "ols" means that the estimated regression coefficients from fitting a linear model with lm. • The third option is to manually provide starting values as either a vector, column matrix or row matrix.
covar	logical. Indicates whether or not the covariance matrix should be estimated. If TRUE the covariance matrix is estimated using bootstrap. The default number of replicates is 2000 but this can be adjusted (see argument ...). However, since the bootstrap procedure is time-consuming the default is covar=FALSE.
na.action	a function which indicates what should happen when the data contain NAs.
digits	the number of digits to be printed
level	the desired level of confidence, for confidence intervals provided by summary.stls. A number between 0 and 1. The default value is 0.95.
...	additional arguments. For stls the number of bootstrap replicates can be adjusted by setting R=the desired number of replicates. Also the control argument of optim can be set by control=list() (for more information, see Details).

Details

Uses optim ("Nelder–Mead" method) to minimize the objective function described in Powell (1986) wrt the vector of regression coefficients in order to find the STLS estimates (see Karlsson and Lindmark 2014 for more detailed information and background). The maximum number of iterations is set at 2000, but this can be adjusted by setting control=list(maxit=...) (for more information see the documentation for optim).

As the starting values of the regression coefficients can have a great impact on the result of the minimization it is recommended to use one of the methods for generating these rather than supplying the values manually (unless one is confident that one has a good idea of what the starting values should be).

Value

stls returns an object of class "stls".

The function summary prints a summary of the results, including two types of confidence intervals (normal approximation and percentile method). The generic accessor functions coef, fitted, residuals and vcov extract various useful features of the value returned by stls

An object of class "stls", a list with elements:

coefficients	the named vector of coefficients
startcoef	the starting values of the regression coefficients used by optim
value	the value of the objective function corresponding to coefficients
counts	number of iterations used by optim. See the documentation for optim for further details
convergence	from optim. An integer code. 0 indicates successful completion. Possible error codes are 1 indicating that the iteration limit maxit had been reached. 10 indicating degeneracy of the Nelder–Mead simplex.
message	from optim. A character string giving any additional information returned by the optimizer, or NULL.
residuals	the residuals of the model
fitted.values	the fitted values
df.residual	the residual degrees of freedom
call	the matched call
covariance	if covar=TRUE, the estimated covariance matrix
R	if covar=TRUE, the number of bootstrap replicates
bootrepl	if covar=TRUE, the bootstrap replicates

Author(s)

Anita Lindmark and Maria Karlsson

References

Karlsson, M., Lindmark, A. (2014) truncSP: An R Package for Estimation of Semi-Parametric Truncated Linear Regression Models, *Journal of Statistical Software*, **57(14)**, pp 1–19, http://www.jstatsoft.org/v57/i14/

Powell, J. (1986) Symmetrically Trimmed Least Squares Estimation for Tobit Models, *Econometrika*, **54(6)**, pp 1435–1460

See Also

stls.fit, the function that does the actual fitting

qme, for estimation of models with truncated response variables using the QME estimator

lt, for estimation of models with truncated response variables using the LT estimator

truncreg for estimating models with truncated response variables by maximum likelihood, assuming Gaussian errors

Examples

```
##Simulate a data.frame
n <- 10000
x1 <- runif(n,0,10)
x2 <- runif(n,0,10)
x3 <- runif(n,-5,5)
y <- 1-2*x1+x2+2*x3+rnorm(n,0,2)
d <- data.frame(y=y,x1=x1,x2=x2,x3=x3)

##Use a truncated subsample
dtrunc <- subset(d, y>0)

##Use stls to estimate the model
stls(y~x1+x2+x3, dtrunc, point=0, direction="left", beta="ml", covar=FALSE)


##Example using data "PM10trunc"
data(PM10trunc)

stlspm10 <-
stls(PM10~cars+temp+wind.speed+temp.diff+wind.dir+hour+day, data=PM10trunc, point=2)

summary(stlspm10)
```

---

stls-class *Class "stls"*

Description

Documentation on S4 class "stls".

Objects from the Class

Objects from the class are usually obtained by a call to the function stls.

Slots

call: Object of class "call" the function call

coefficients: Object of class "matrix" the estimated coefficients from fitting a model for truncated regression using the Quadratic Mode Estimator (QME)

startcoef: Object of class "matrix" the starting coefficients used when fitting the model

value: Object of class "numeric" the value of the objective function corresponding to coefficients

counts: Object of class "integer" number of iterations until convergence

convergence: Object of class "integer" indicating whether convergence was achieved

message: Object of class "character" a character string giving any additional information returned by the optimizer

`residuals`: Object of class `"matrix"` the residuals of the model

`fitted.values`: Object of class `"matrix"` the fitted values

`df.residual`: Object of class `"integer"` the residual degrees of freedom

`covariance`: Object of class `"matrix"` the estimated covariance matrix

`bootrepl`: Object of class `"matrix"` bootstrap replicates used to estimate the covariance matrix

Methods

coef `signature(object = "stls")`: extracts the coefficients of the model fitted using `stls`

fitted `signature(object = "stls")`: extracts the fitted values of the model fitted using `stls`

print `signature(x = "stls")`: print method

residuals `signature(object = "stls")`: extracts the residuals of the model fitted using `stls`

summary `signature(object = "stls")`: summary method

vcov `signature(object = "stls")`: extracts the covariance matrix of the model fitted using `stls`

Author(s)

Anita Lindmark and Maria Karlsson

See Also

Function `stls` and class `"summary.stls"`

Examples

```
showClass("stls")
```

---

stls.fit *Function for fitting STLS*

Description

Function that utilizes `optim` to find STLS estimates of the regression coefficients for regression models with truncated response variables. Intended to be called through `stls`, not on its own, since `stls` also transforms data into the correct form etc.

Usage

```
stls.fit(formula,mf, point, direction, bet, ...)
```

Arguments

formula	a symbolic description of the model to be estimated
mf	the model.frame containing the variables to be used when fitting the model. stls transforms the model frame to the correct form before calling stls.fit. If stls.fit is called on its own the model frame needs to be transformed manually.
point	point of truncation
direction	direction of truncation
bet	starting values to be used by optim. Column matrix with p rows.
...	additional arguments to be passed to optim (see the documentation for stls for further details).

Value

a list with components:

startcoef	the starting values of the regression coefficients used by optim
coefficients	the named vector of coefficients
counts	number of iterations used by optim. See the documentation for optim for further details
convergence	from optim. An integer code. 0 indicates successful completion. Possible error codes are 1 indicating that the iteration limit maxit had been reached. 10 indicating degeneracy of the Nelder–Mead simplex.
message	from optim. A character string giving any additional information returned by the optimizer, or NULL.
residuals	the residuals of the model
df.residual	the residual degrees of freedom
fitted.values	the fitted values

Author(s)

Anita Lindmark and Maria Karlsson

See Also

stls

Examples

```
require(utils)
##Model frame
n <- 10000
x <- rnorm(n,0,2)
y <- 2+x+4*rnorm(n)
d <- data.frame(y=y, x=x)
```

```
dl0 <- subset(d, y>0)
mf <- model.frame(y~x, data=dl0)


##Starting values
lmmod <- lm(data=mf)
bet <- lmmod$coef
bet <- matrix(bet)

str(stls. <- stls.fit(y~x,mf,point=0,direction="left",bet))
```

---

summary.lt-class *Class* "summary.lt"

Description

Documentation on S4 class "summary.lt"

Objects from the Class

Objects from the class are usually obtained by a calling summary on an object of class "lt".

Slots

level: Object of class "numeric" the level of confidence for confidence intervals

confint: Object of class "matrix" confidence intervals for regression coefficients

bootconfint: Object of class "matrix" bootstrap confidence intervals for regression coefficients

call: Object of class "call" the function call

coefficients: Object of class "matrix" the estimated coefficients from fitting a model for truncated regression using the Quadratic Mode Estimator (QME)

startcoef: Object of class "matrix" the starting coefficients used when fitting the model

cvalues: Object of class "data.frame" containing information about the threshold values used

value: Object of class "numeric" the value of the objective function corresponding to coefficients

counts: Object of class "integer" number of iterations until convergence

convergence: Object of class "integer" indicating whether convergence was achieved

message: Object of class "character" a character string giving any additional information returned by the optimizer

residuals: Object of class "matrix" the residuals of the model

fitted.values: Object of class "matrix" the fitted values

df.residual: Object of class "integer" the residual degrees of freedom

covariance: Object of class "matrix" the estimated covariance matrix

bootrepl: Object of class "matrix" bootstrap replicates used to estimate the covariance matrix

Extends

Class "lt", directly.

Methods

print signature(x = "summary.lt"): print method

Author(s)

Anita Lindmark and Maria Karlsson

See Also

Function lt and class "lt"

Examples

```
showClass("summary.lt")
```

---

summary.qme-class *Class* "summary.qme"

Description

Documentation on S4 class "summary.qme"

Objects from the Class

Objects from the class are usually obtained by a calling summary on an object of class "qme".

Slots

level: Object of class "numeric" the level of confidence for confidence intervals

confint: Object of class "matrix" confidence intervals for regression coefficients

bootconfint: Object of class "matrix" bootstrap confidence intervals for regression coefficients

call: Object of class "call" the function call

coefficients: Object of class "matrix" the estimated coefficients from fitting a model for truncated regression using the Quadratic Mode Estimator (QME)

startcoef: Object of class "matrix" the starting coefficients used when fitting the model

cval: Object of class "data.frame" containing information on the threshold value used

value: Object of class "numeric" the value of the objective function corresponding to coefficients

counts: Object of class "integer" number of iterations until convergence

convergence: Object of class "integer" indicating whether convergence was achieved

message: Object of class "character" a character string giving any additional information returned by the optimizer

`residuals`: Object of class `"matrix"` the residuals of the model

`fitted.values`: Object of class `"matrix"` the fitted values

`df.residual`: Object of class `"integer"` the residual degrees of freedom

`covariance`: Object of class `"matrix"` the estimated covariance matrix

`bootrepl`: Object of class `"matrix"` bootstrap replicates used to estimate the covariance matrix

Extends

Class `"qme"`, directly.

Methods

print `signature(x = "summary.qme")`: print method

Author(s)

Anita Lindmark and Maria Karlsson

See Also

Function `qme` and class `"qme"`

Examples

```
showClass("summary.qme")
```

---

summary.stls-class *Class "summary.stls"*

Description

Documentation on S4 class `"summary.stls"`

Objects from the Class

Objects from the class are usually obtained by a calling `summary` on an object of class `"stls"`.

Slots

`level`: Object of class `"numeric"` the level of confidence for confidence intervals

`confint`: Object of class `"matrix"` confidence intervals for regression coefficients

`bootconfint`: Object of class `"matrix"` bootstrap confidence intervals for regression coefficients

`call`: Object of class `"call"` the function call

`coefficients`: Object of class `"matrix"` the estimated coefficients from fitting a model for truncated regression using the Quadratic Mode Estimator (QME)

`startcoef`: Object of class `"matrix"` the starting coefficients used when fitting the model

`value`: Object of class `"numeric"` the value of the objective function corresponding to `coefficients`

`counts`: Object of class `"integer"` number of iterations until convergence

`convergence`: Object of class `"integer"` indicating whether convergence was achieved

`message`: Object of class `"character"` a character string giving any additional information returned by the optimizer

`residuals`: Object of class `"matrix"` the residuals of the model

`fitted.values`: Object of class `"matrix"` the fitted values

`df.residual`: Object of class `"integer"` the residual degrees of freedom

`covariance`: Object of class `"matrix"` the estimated covariance matrix

`bootrepl`: Object of class `"matrix"` bootstrap replicates used to estimate the covariance matrix

Extends

Class `"stls"`, directly.

Methods

print `signature(x = "summary.stls")`: print method

Author(s)

Anita Lindmark and Maria Karlsson

See Also

Function `stls` and class `"stls"`

Examples

```
showClass("summary.stls")
```

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