

# Package ‘censReg’

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**Title** Censored Regression (Tobit) Models

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**Depends** R (>= 2.4.0), maxLik (>= 0.7-3)

**Imports** glmmML (>= 0.81-6), sandwich (>= 2.2-6), miscTools (>= 0.6-11), stats (>= 2.15.0), plm

**Suggests** AER, lmtest (>= 0.9-27)

**Description** Maximum Likelihood estimation of censored regression (Tobit) models with cross-sectional and panel data.

**License** GPL (>= 2)

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## R topics documented:

censReg . . . . .	2
coef.censReg . . . . .	4
coef.summary.censReg . . . . .	5
margEff.censReg . . . . .	6
summary.censReg . . . . .	8

<b>Index</b>	<b>10</b>
--------------	-----------

censReg

*Censored Regression (Tobit) Model***Description**

Fitting a model with a censored dependent variable.

**Usage**

```
censReg( formula, left = 0, right = Inf, data = sys.frame( sys.parent() ),
         start = NULL, nGHQ = 8, logLikOnly = FALSE, ... )

## S3 method for class 'censReg'
print( x, logSigma = TRUE, digits = 4, ... )
```

**Arguments**

formula	an object of class "formula": a symbolic description of the model to be fitted.
left	left limit for the censored dependent variable; if set to $-\text{Inf}$ , the dependent variable is assumed to be not left-censored; defaults to zero (classical Tobit model).
right	right limit for the censored dependent variable; if set to $\text{Inf}$ , the dependent variable is assumed to be not right-censored; defaults to $\text{Inf}$ (classical Tobit model).
data	an optional data frame. If argument data is of class "pdata.frame", a panel-model is estimated.
start	an optional vector of initial parameters for the ML estimation (intercept, slope parameters, logarithm of the standard deviation of the individual effects (only for random-effects panel data models), and logarithm of the standard deviation of the general disturbance term); if start is not specified, initial values are taken from an OLS estimation or (uncensored) random-effects panel data estimation.
nGHQ	number of points used in the Gauss-Hermite quadrature, which is used to compute the log-likelihood value in case of the random effects model for panel data.
logLikOnly	logical. If TRUE, the model is not estimated but the log-likelihood contributions of all observations/individuals and the corresponding gradients calculated at the parameters specified by argument start are returned.
x	object of class censReg (returned by censReg).
logSigma	logical value indicating whether the variance(s) of the model should be printed logarithmized (see <code>coef.censReg</code> ).
digits	positive integer specifying the minimum number of significant digits to be printed (see <code>print.default</code> ).
...	additional arguments for censReg are passed to <code>maxLik</code> ; additional arguments for <code>print.censReg</code> are currently ignored.

## Details

The model is estimated by Maximum Likelihood (ML) assuming a Gaussian (normal) distribution of the error term. The maximization of the likelihood function is done by function `maxLik` of the **maxLik** package. An additional argument `method` can be used to specify the optimization method used by `maxLik`, e.g. "Newton-Raphson", "BHHH", "BFGS", "SANN" (for simulated annealing), or "NM" (for Nelder-Mead).

## Value

If argument `logLikOnly` is FALSE (default), `censReg` returns an object of class "censReg" inheriting from class "maxLik". The returned object contains the same components as objects returned by `maxLik` and additionally the following components:

<code>call</code>	the matched call.
<code>terms</code>	the model terms.
<code>nObs</code>	a vector containing 4 integer values: the total number of observations, the number of left-censored observations, the number of uncensored observations, and the number of right-censored observations.
<code>df.residual</code>	degrees of freedom of the residuals.
<code>start</code>	vector of starting values.
<code>left</code>	left limit of the censored dependent variable.
<code>right</code>	right limit of the censored dependent variable.
<code>xMean</code>	vector of mean values of the explanatory variables.

In contrast, if argument `logLikOnly` is TRUE, `censReg` returns a vector of the log-likelihood contributions of all observations/individuals. This vector has an attribute "gradient", which is a matrix containing the gradients of the log-likelihood contributions with respect to the parameters.

## Note

When the censored regression model is estimated, the log-likelihood function is maximized with respect to the coefficients and the *logarithm(s)* of the variance(s).

## Author(s)

Arne Henningsen

## References

- Greene, W.H. (2008): *Econometric Analysis*, Sixth Edition, Prentice Hall, p. 871-875.
- Kleiber, C. and Zeileis, A. (2008): *Applied Econometrics with R*, Springer, p. 141-143.
- Tobin, J. (1958): Estimation of Relationships for Limited Dependent Variables. *Econometrica* 26, p. 24-36.

## See Also

[summary.censReg](#), [coef.censReg](#), [tobit](#), [selection](#)

**Examples**

```
## Kleiber & Zeileis ( 2008 ), page 142
data( "Affairs", package = "AER" )
estResult <- censReg( affairs ~ age + yearsmarried + religiousness +
  occupation + rating, data = Affairs )
print( estResult )

## Kleiber & Zeileis ( 2008 ), page 143
estResultBoth <- censReg( affairs ~ age + yearsmarried + religiousness +
  occupation + rating, data = Affairs, right = 4 )
print( estResultBoth )
```

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coef.censReg	<i>Coefficients, their Covariances, and Log-Likelihood Values of Censored Regression Models</i>
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**Description**

These functions extract the coefficient vectors, the corresponding covariance matrices, and log-likelihood values from censored regression models.

**Usage**

```
## S3 method for class 'censReg'
coef( object, logSigma = TRUE, ... )

## S3 method for class 'censReg'
vcov( object, logSigma = TRUE, ... )

## S3 method for class 'censReg'
logLik( object, ... )
```

**Arguments**

object	object of class "censReg" (returned by <code>censReg</code> ).
logSigma	logical value indicating whether the variance(s) of the model should be returned logarithmized.
...	currently not used.

**Value**

`coef.censReg` returns a vector of the estimated coefficients.

`vcov.censReg` returns the covariance matrix of the estimated coefficients.

`logLik.censReg` returns an object of class "logLik". This object is the log-likelihood value of the estimated model and has an attribute "df" that gives the degrees of freedom, i.e. the number of estimated parameters.

**Note**

When the censored regression model is estimated, the log-likelihood function is maximized with respect to the coefficients and the *logarithm(s)* of the variance(s). Hence, if argument `logSigma` is `FALSE`, the variance(s) of the model is/are calculated by applying the exponential function to the estimated logarithmized variance(s) and the covariance matrix of all parameters is calculated by the Delta method.

**Author(s)**

Arne Henningsen

**See Also**

[censReg](#), [summary.censReg](#), and [coef.summary.censReg](#)

**Examples**

```
## Kleiber & Zeileis ( 2008 ), page 142
data( "Affairs", package = "AER" )
estResult <- censReg( affairs ~ age + yearsmarried + religiousness +
  occupation + rating, data = Affairs )
coef( estResult )
coef( estResult, logSigma = FALSE )
vcov( estResult )
vcov( estResult, logSigma = FALSE )
logLik( estResult )
```

---

`coef.summary.censReg` *Coefficients of Censored Regression Models and their Statistical Properties*

---

**Description**

This function returns the estimated coefficients of censored regression models as well as their standard errors, z-values, and P-values.

**Usage**

```
## S3 method for class 'summary.censReg'
coef( object, logSigma = TRUE, ... )
```

**Arguments**

<code>object</code>	object of class "summary.censReg" (returned by <a href="#">summary.censReg</a> ).
<code>logSigma</code>	logical value indicating whether the variance(s) of the model should be returned logarithmized.
<code>...</code>	currently not used.

**Value**

coef.summary.censReg returns an matrix, where each row corresponds to one coefficient and the 4 rows contain the estimated coefficients, their standard errors, z-values, and P-values.

**Author(s)**

Arne Henningsen

**See Also**

[censReg](#), [summary.censReg](#) and [coef.censReg](#)

**Examples**

```
## Kleiber & Zeileis ( 2008 ), page 142
data( "Affairs", package = "AER" )
estResult <- censReg( affairs ~ age + yearsmarried + religiousness +
  occupation + rating, data = Affairs )
coef( summary( estResult ) )
```

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margEff.censReg

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*Marginal Effects in Censored Regression Models*


---

**Description**

The margEff method computes the marginal effects of the explanatory variables on the expected value of the dependent variable evaluated. Please note that this functionality is currently not available for panel data models.

**Usage**

```
## S3 method for class 'censReg'
margEff( object, xValues = NULL,
  calcVCov = TRUE, returnJacobian = FALSE, ... )

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

**Arguments**

object	argument object of the margEff method must be an object of class "censReg" (returned by <a href="#">censReg</a> ); argument object of the summary method must be an object of class "margEff.censReg" (returned by <a href="#">margEff.censReg</a> ).
xValues	vector that specifies the values of the explanatory variables (including the intercept if it is included in the model), at which the marginal effects should be calculated. The number and order of the elements of this vector must correspond to the number and order of the estimated coefficients (without sigma). If this argument is NULL (or not specified), argument xValues is set to the mean values of the explanatory variables.

calcVCov	logical. If TRUE, the approximate variance covariance matrices of the marginal effects is calculated and returned as an attribute (see below).
returnJacobian	logical. If TRUE, the Jacobian of the marginal effects with respect to the coefficients is returned as an attribute (see below).
...	currently not used.

## Value

margEff.censReg returns an object of class "margEff.censReg", which is a vector of the marginal effects of the explanatory variables on the expected value of the dependent variable evaluated at the mean values of the explanatory variables. The returned object has an attribute df.residual, which is equal to the degrees of freedom of the residuals.

If argument calcVCov is TRUE, the object returned by margEff.censReg has an attribute vcov, which is a the approximate variance covariance matrices of the marginal effects calculated with the Delta method.

If argument returnJacobian is TRUE, the object returned by margEff.censReg has an attribute jacobian, which is the Jacobian of the marginal effects with respect to the coefficients.

summary.margEff.censReg returns an object of class "summary.margEff.censReg", which is a matrix with four columns, where the first column contains the marginal effects, the second column contains the standard errors of the marginal effects, the third column contains the corresponding t-values, and the fourth columns contains the corresponding P values.

## Author(s)

Arne Henningsen

## See Also

[censReg](#), [coef.censReg](#), and [summary.censReg](#)

## Examples

```
## Kleiber & Zeileis ( 2008 ), page 142
data( "Affairs", package = "AER" )
estResult <- censReg( affairs ~ age + yearsmarried + religiousness +
  occupation + rating, data = Affairs )
margEff( estResult )
summary( margEff( estResult ) )
margEff( estResult, xValues = c( 1, 40, 4, 2, 4, 4 ) )
```

---

summary.censReg      *Summary Results of Censored Regression Models*

---

## Description

These methods prepare and print summary results for censored regression models.

## Usage

```
## S3 method for class 'censReg'  
summary( object, ... )  
  
## S3 method for class 'summary.censReg'  
print( x, logSigma = TRUE, digits = 4, ... )
```

## Arguments

object	object of class "censReg" (returned by <a href="#">censReg</a> ).
x	object of class "summary.censReg" (returned by <a href="#">summary.censReg</a> ).
logSigma	logical value indicating whether the variance(s) of the model should be printed logarithmized.
digits	positive integer specifying the minimum number of significant digits to be printed (passed to <a href="#">printCoefmat</a> ).
...	currently not used.

## Value

`summary.censReg` returns an object of class "summary.censReg" inheriting from class "summary.maxLik". The returned object contains the same components as objects returned by [summary.maxLik](#) and additionally the following components:

call	the matched call.
nObs	a vector containing 4 integer values: the total number of observations, the number of left-censored observations, the number of uncensored observations, and the number of right-censored observations.

## Author(s)

Arne Henningsen

## See Also

[censReg](#), [coef.summary.censReg](#), and [coef.censReg](#)



### **Examples**

```
## Kleiber & Zeileis ( 2008 ), page 142
data( "Affairs", package = "AER" )
estResult <- censReg( affairs ~ age + yearsmarried + religiousness +
  occupation + rating, data = Affairs )
summary( estResult )
```

# Index

## \*Topic **methods**

- coef.censReg, 4
- coef.summary.censReg, 5
- margEff.censReg, 6
- summary.censReg, 8

## \*Topic **models**

- censReg, 2

## \*Topic **regression**

- censReg, 2

censReg, 2, 4–8

coef.censReg, 2, 3, 4, 6–8

coef.summary.censReg, 5, 5, 8

logLik.censReg (coef.censReg), 4

margEff.censReg, 6

maxLik, 2, 3

print.censReg (censReg), 2

print.default, 2

print.summary.censReg  
(summary.censReg), 8

printCoefmat, 8

selection, 3

summary.censReg, 3, 5–8, 8

summary.margEff.censReg  
(margEff.censReg), 6

summary.maxLik, 8

tobit, 3

vcov.censReg (coef.censReg), 4