

# Package ‘ssmrob’

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**Type** Package

**Title** Robust Estimation and Inference in Sample Selection Models

**Version** 0.6

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**Description** Package provides a set of tools for robust estimation and inference for models with sample selectivity.

**License** GPL-2

**Imports** sampleSelection, robustbase, MASS

**Suggests** mvtnorm

**NeedsCompilation** no

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ssmrob-package	<i>Robust Estimation and Inference in Sample Selection Models</i>
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### Description

Package provides a set of tools for robust estimation and inference for models with sample selectivity.

### Details

Package: ssmrob  
 Type: Package  
 Version: 0.6  
 Date: 2019-04-30  
 License: GPL-2

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti  
 Maintainer: Mikhail Zhelonkin <Mikhail.Zhelonkin@gmail.com>

**References**

Heckman, J.J. (1979) Sample Selection Bias as a Specification Error. *Econometrica*, 47, p. 153-161.  
 Zhelonkin, M., Genton M.G., and Ronchetti, E. (2016) Robust Inference in Sample Selection Models. *Journal of the Royal Statistical Society, Series B*, 78, p. 805-827.

**See Also**

[ssmrob](#), [etregrob](#), [heckitrob](#), [heckit5rob](#), [selection](#)

**Examples**

```
# Zhelonkin, Genton, Ronchetti (2016): page 823
data(MEPS2001)
attach(MEPS2001)
selectEq <- dambexp ~ age + female + educ + blhisp + totchr + ins
outcomeEq <- lnambx ~ age + female + educ + blhisp + totchr + ins
meps.fit <- ssmrob(selectEq, outcomeEq, control = heckitrob.control(tcc = 3.2))
summary(meps.fit)
```

---

 coef.etregrob

---

*Extract Coefficients from Robust Endogenous Treatment Model Fit*


---

**Description**

Returns the coefficients of the robust two-stage estimator for endogenous treatment model.

**Usage**

```
## S3 method for class 'etregrob'
coef(object, ...)
```

**Arguments**

object	object of class " <a href="#">"etregrob"</a> "
...	currently not used

**Value**

Returns a list of two vectors of parameters of two stages.

S	coefficients of the selection equation.
O	coefficients of the outcome equation.

**Author(s)**

Mikhail Zhelonkin

---

coef.heckit5rob      *Extract Coefficients from Robust Sample Selection Model Fit*


---

**Description**

Returns the coefficients of the robust two-stage estimator for simple Heckman's selection model or switching regression model.

**Usage**

```
## S3 method for class 'heckit5rob'
coef(object, ...)
```

**Arguments**

object	object of class "heckitrob" or "heckit5rob"
...	currently not used

**Value**

Returns a list of two (censored) or three (switching) vectors of parameters of two stages.

S	coefficients of the selection equation.
0	coefficients of the outcome equation(s).

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

coef.heckitrob      *Extract Coefficients from Robust Sample Selection Model Fit*


---

**Description**

Returns the coefficients of the robust two-stage estimator for simple Heckman's selection model or switching regression model.

**Usage**

```
## S3 method for class 'heckitrob'
coef(object, ...)
```

**Arguments**

object	object of class "heckitrob" or "heckit5rob"
...	currently not used

**Value**

Returns a list of two (censored) or three (switching) vectors of parameters of two stages.

S	coefficients of the selection equation.
O	coefficients of the outcome equation(s).

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

dLambdadSM	<i>Inverse Mills Ratio Derivative</i>
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---

**Description**

Computes a derivative of the inverse Mills ratio with respect to the parameter vector.

**Usage**

```
dLambdadSM(x, beta)
```

**Arguments**

x	vector of exogenous variables
beta	vector of parameters

**Details**

This function is necessary for computation of the asymptotic variance. In case of switching regressions the inverse Mills ratio term is different, and its derivative is computed in function dLambdadSM5. It can be also used to compute the influence function of the two-stage estimator.

**Value**

The gradient of the inverse Mills ratio is returned as a vector

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**References**

Zhelonkin, M., Genton M.G., and Ronchetti, E. (2016) Robust Inference in Sample Selection Models. *Journal of the Royal Statistical Society, Series B*, 78, p. 805-827.

---

dLambdadSM5                      *Inverse Mills Ratio Derivative*

---

### Description

Computes a derivative of the inverse Mills ratio with respect to the parameter vector.

### Usage

```
dLambdadSM5(x, beta)
```

### Arguments

x	vector of exogenous variables
beta	vector of parameters

### Details

This function is necessary for computation of the asymptotic variance. In case of switching regressions the inverse Mills ratio term is different, and its derivative is computed in function dLambdadSM5. It can also be used to compute the influence function of the two-stage estimator.

### Value

The gradient of the inverse Mills ratio is returned as a vector

### Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

### References

Zhelonkin, M., Genton M.G., and Ronchetti, E. (2016) Robust Inference in Sample Selection Models. *Journal of the Royal Statistical Society, Series B*, 78, p. 805-827.

---

etreg2steprobVcov                      *Variance Covariance Matrix*

---

### Description

Computation of the asymptotic variance matrix of the robust Heckman's two-stage estimator for endogenous treatment model.

### Usage

```
etreg2steprobVcov(y1vec, y2vec, x1Matr, x2Matr, eststage1, eststage2, eststage2sigma,
weights = rep(1, nrow(y1vec)), t.c = 1.345)
```

**Arguments**

y1vec	vector of endogenous variables of the selection stage
y2vec	vector of endogenous variables of the outcome stage
x1Matr	matrix of exogenous variables of the selection stage
x2Matr	matrix of exogenous variables of the outcome stage
eststage1	object of class "glmrob", corresponding to the robust probit fit
eststage2	vector of the coefficients of the outcome stage
eststage2sigma	the robust scale estimate of the second stage regression
weights	robustness weights
t.c	tuning constant of the second stage

**Details**

The computation is made using the Huber (1967) - White (1980) sandwich estimator. In the computation of leverage weights the lambda's are assumed to be fixed.

**Value**

Variance covariance matrix of the second stage estimator

**Author(s)**

Mikhail Zhelonkin

**References**

Huber, P.J. (1967) The Behavior of Maximum Likelihood Estimates under Nonstandard Conditions. *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability; L.M. LeCam, J. Neyman (Eds.), Berkeley: University of California Press*, p. 221-233.

White, H.J. (1980) A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, 48, p. 817-838.

---

 etregrob

*Robust Fit of Endogenous Treatment Model*


---

**Description**

Fits the endogenous treatment model using a robust two-stage estimator

**Usage**

```
etregrob(selection, outcome, control = heckitrob.control())
```

**Arguments**

selection	formula, the selection equation
outcome	formula, the outcome equation
control	a list of parameters for controlling the fitting process. The same list as for sample selection model

**Details**

Compute robust two-step estimates of the Endogenous Treatment Model. The robust probit is fitted in the first stage. In the second stage the Mallows type M-estimator is used instead of traditional OLS. The correction for endogeneity is made by means of control function, which is the inverse Mills ratio for a complete sample (see Maddala, 1983, p. 120-122). The values of the tuning constants and the robustness weights can be modified in [heckitrob.control](#).

**Value**

Object of class "etregrob".

stage1	object of class glmrob that contains robust probit fit
stage2	object of class rlm that contains second stage robust fit
vcov	variance matrix of the second stage
call	the matched call
method	method of estimation, currently only "robust two-stage" is implemented

**Note**

The treatment variable is automatically included in the formula for the second estimation step, i.e. one should not add the dependent variable from the selection equation in the formula of the outcome equation.

**Author(s)**

Mikhail Zhelonkin

**References**

Maddala G.S. (1983) Limited-Dependent and Qualitative Variables in Econometrics. Cambridge: Cambridge University Press.

**See Also**

[glmrob](#), [rlm](#), [ssmrob](#), [heckitrob.control](#)



**Examples**

```

library(mvtnorm)
set.seed(2)
N <- 5000
beta1 <- c(1.0, 1.0, 0.75)
beta2 <- c(1.5, 1.0, 0.5)
alpha <- 1.25
x1 <- rmvnorm(N, mean = c(0, -1, 1), sigma = diag(c(1, 0.5, 1)))
x2 <- x1
x2[, 3] <- rnorm(N, 1, 1)
eps <- rmvnorm(N, mean = rep(0, 2), sigma = matrix(c(1, -0.7, -0.7, 1), 2, 2))
x1beta1 <- x1[, 1]*beta1[1] + x1[, 2]*beta1[2] + x1[, 3]*beta1[3]
x2beta2 <- x2[, 1]*beta2[1] + x2[, 2]*beta2[2] + x2[, 3]*beta2[3]
y1 <- ifelse(x1beta1 + eps[, 1] > 0, 1, 0)
y2 <- x2beta2 + alpha*y1 + eps[,2]
etmsim.fit <- etregrob(y1 ~ x1, y2 ~ x2,
                      control = heckitrob.control(weights.x1 = "hat",
                                                  weights.x2 = "covMcd"))
summary(etmsim.fit)

```

---

fitted.etregrob

*Fitted values of endogenous treatment model*


---

**Description**

Calculate the fitted values of the endogenous treatment model using robust fit.

**Usage**

```

## S3 method for class 'etregrob'
fitted(object, ...)

```

**Arguments**

object	object of class " <code>etregrob</code> "
...	currently not used

**Value**

vector of fitted values

**Author(s)**

Mikhail Zhelonkin

---

fitted.heckit5rob      *Fitted values of robust sample selection model*

---

**Description**

Calculate the fitted values of the sample selection model using robust fit.

**Usage**

```
## S3 method for class 'heckit5rob'  
fitted(object, ...)
```

**Arguments**

object	object of class "heckitrob" or object of class "heckit5rob"
...	currently not used

**Details**

In case of truncated selection model one vector of fitted values is returned. In case of switching regression model a list, that contains two vectors corresponding to two regimes, is returned.

**Value**

vector of fitted values or a list that contains two vectors of fitted values

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

fitted.heckitrob      *Fitted values of robust sample selection model*

---

**Description**

Calculate the fitted values of the sample selection model using robust fit.

**Usage**

```
## S3 method for class 'heckitrob'  
fitted(object, ...)
```

**Arguments**

object            object of class "heckitrob" or object of class "heckit5rob"  
 ...                currently not used

**Details**

In case of truncated selection model one vector of fitted values is returned. In case of switching regression model a list, that contains two vectors corresponding to two regimes, is returned.

**Value**

vector of fitted values or a list that contains two vectors of fitted values

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

heck2steprobVcov            *Variance Covariance Matrix*

---

**Description**

Computation of the asymptotic variance matrix of the robust Heckman's two-stage estimator for truncated selection model.

**Usage**

```
heck2steprobVcov(y1vec, y2vec, x1Matr, x2Matr, eststage1, eststage2,
                 eststage2sigma, weights = rep(1,nrow(y1vec)), t.c = 1.345)
```

**Arguments**

y1vec            vector of endogenous variables of the selection stage  
 y2vec            vector of endogenous variables of the outcome stage  
 x1Matr           matrix of exogenous variables of the selection stage  
 x2Matr           matrix of exogenous variables of the outcome stage  
 eststage1        object of class "glmrob", corresponding to the robust probit fit  
 eststage2        vector of the coefficients of the outcome stage  
 eststage2sigma   the robust scale estimate of the second stage regression  
 weights          vector of robustness weights  
 t.c               tuning constant of the second stage

**Details**

The computation is made using the Huber (1967) - White (1980) sandwich estimator with Heckman (1979) correction. In the computation of leverage weights the lambda's are assumed to be fixed.

**Value**

Variance covariance matrix of the second stage estimator

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**References**

Heckman, J.J. (1979) Sample Selection Bias as a Specification Error. *Econometrica*, 47, p. 153-161.

Huber, P.J. (1967) The Behavior of Maximum Likelihood Estimates under Nonstandard Conditions. *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability; L.M. LeCam, J. Neyman (Eds.), Berkeley: University of California Press*, p. 221-233.

White, H.J. (1980) A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, 48, p. 817-838.

**See Also**

[glmrob](#)

---

heck5twosteprobVcov     *Variance Covariance Matrix*

---

**Description**

Computation of the asymptotic variance matrix of the robust Heckman's two-stage estimator for the second regime of switching regression model, i.e. when  $y_1 = 0$ .

**Usage**

```
heck5twosteprobVcov(y1vec, y2vec, x1Matr, x2Matr, eststage1, eststage2,
                    eststage2sigma, weights = rep(1,nrow(y1vec)), t.c = 1.345)
```

**Arguments**

y1vec	vector of endogenous variables of the selection stage
y2vec	vector of endogenous variables of the outcome stage
x1Matr	matrix of exogenous variables of the selection stage
x2Matr	matrix of exogenous variables of the outcome stage
eststage1	object of class "glmrob", corresponding to the robust probit fit
eststage2	vector of the coefficients of the outcome stage
eststage2sigma	the robust scale estimate of the second stage regression
weights	vector of robustness weights
t.c	tuning constant of the second stage

**Details**

The computation is made using the Huber (1967) - White (1980) sandwich estimator with Heckman (1979) correction. In the computation of leverage weights the  $\lambda$ 's are assumed to be fixed.

**Value**

Variance covariance matrix of the second stage estimator

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**References**

- Amemiya, T. (1984) Tobit Models: a Survey. *Journal of Econometrics*, 24, p. 3-61.
- Heckman, J.J. (1979) Sample Selection Bias as a Specification Error. *Econometrica*, 47, p. 153-161.
- Huber, P.J. (1967) The Behavior of Maximum Likelihood Estimates under Nonstandard Conditions. *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability; L.M. LeCam, J. Neyman (Eds.), Berkeley: University of California Press*, p. 221-233.
- White, H.J. (1980) A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, 48, p. 817-838.

---

heckit5rob

*Robust Heckit Fit: Switching Regressions*

---

**Description**

Fits the switching regression model with probit selection using a robust two-stage estimator

**Usage**

```
heckit5rob(selection, outcome1, outcome2, control = heckitrob.control())
```

**Arguments**

selection	formula, the selection equation
outcome1	formula, first outcome equation
outcome2	formula, second outcome equation
control	a list of parameters for controlling the fitting process

**Details**

Compute robust two-stage estimates of the switching regression model with probit selection. The robust probit is fitted in the first stage. In the second stage the Mallows type M-estimators are used. The values of the tuning constants and the robustness weights can be modified in [heckitrob.control](#).

**Value**

Object of class "heckit5rob".

stage1	object of class <code>glmrob</code> that contains (first stage) robust probit fit
stage21	object of class <code>rlm</code> that contains second stage first regime robust fit
stage22	object of class <code>rlm</code> that contains second stage second regime robust fit
vcov1	variance matrix of the second stage first regime
vcov2	variance matrix of the second stage second regime
call	the matched call
method	method of estimation, currently only "robust two-stage" is implemented

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**References**

Heckman, J.J. (1979) Sample Selection Bias as a Specification Error. *Econometrica*, 47, p. 153-161.

Zhelonkin, M., Genton M.G., and Ronchetti, E. (2016) Robust Inference in Sample Selection Models. *Journal of the Royal Statistical Society, Series B*, 78, p. 805-827.

**See Also**

[glmrob](#), [rlm](#), [ssmrob](#), [heckitrob](#), [heckitrob.control](#)

**Examples**

```
## Not run:
library(mvtnorm)
set.seed(2)
N <- 5000
beta1 <- c(0, 1.0, 1.0, 0.75)
beta21 <- c(0, 1.5, 1.0, 0.5)
beta22 <- c(1, -1.5, 1.0, 0.5)
covm <- diag(3)
covm[lower.tri(covm)] <- c(0.75, 0.5, 0.25)
covm[upper.tri(covm)] <- covm[lower.tri(covm)]
eps <- rmvnorm(N, rep(0, 3), covm)
x1 <- rmvnorm(N, mean=c(0, -1, 1), sigma=diag(c(1, 0.5, 1)))
x21 <- x1
x22 <- x1
x21[, 3] <- rnorm(N, 1, 1)
x22[, 3] <- rnorm(N, 1, 1)
x1beta1 <- beta1[1] + x1[, 1]*beta1[2] + x1[, 2]*beta1[3] + x1[, 3]*beta1[4]
x21beta21 <- beta21[1] + x21[, 1]*beta21[2] + x21[, 2]*beta21[3] + x21[, 3]*beta21[4]
x22beta22 <- beta22[1] + x22[, 1]*beta22[2] + x22[, 2]*beta22[3] + x22[, 3]*beta22[4]
y1 <- ifelse(x1beta1 + eps[, 1] > 0, 1, 0)
y2 <- ifelse(y1 > 0.5, x21beta21 + eps[, 2],
```

```
x22beta22 + eps[, 3])
srsim.fit <- ssmrob(y1 ~ x1, list(y2 ~ x21, y2 ~ x22),
control = heckitrob.control(weights.x1 = "hat", weights.x2 = "covMcd"))
summary(srsim.fit)

## End(Not run)
```

---

heckitrob

*Robust Heckit Fit*


---

### Description

Fits the sample selection model using a robust two-stage estimator

### Usage

```
heckitrob(selection, outcome, control = heckitrob.control())
```

### Arguments

selection	formula, the selection equation
outcome	formula, the outcome equation
control	a list of parameters for controlling the fitting process

### Details

Compute robust two-stage estimates of the Heckman's selection model. The robust probit is fitted in the first stage. In the second stage the Mallows type M-estimator is used. The values of the tuning constants and the robustness weights can be modified in [heckitrob.control](#).

### Value

Object of class "heckitrob".

stage1	object of class glmrob that contains robust probit fit
stage2	object of class rlm that contains second stage robust fit
vcov	variance matrix of the second stage
call	the matched call
method	method of estimation, currently only "robust two-stage" is implemented

### Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

## References

- Cameron, C.A., Trivedi, P.K. (2009) *Microeconometrics Using Stata*. College Station, TX: Stata Press.
- Heckman, J.J. (1979) Sample Selection Bias as a Specification Error. *Econometrica*, 47, p. 153-161.
- Zhelonkin, M., Genton M.G., and Ronchetti, E. (2016) Robust Inference in Sample Selection Models. *Journal of the Royal Statistical Society, Series B*, 78, p. 805-827.

## See Also

[glmrob](#), [rlm](#), [ssmrob](#), [heckitrob.control](#), [heckit5rob](#), [etregrob](#)

## Examples

```
# Zhelonkin, Genton, Ronchetti (2016): page 823
data(MEPS2001)
attach(MEPS2001)
selectEq <- dambexp ~ age + female + educ + blhisp + totchr + ins
outcomeEq <- lnambx ~ age + female + educ + blhisp + totchr + ins
meps.fit <- ssmrob(selectEq, outcomeEq, control = heckitrob.control(tcc = 3.2))
summary(meps.fit)
```

---

heckitrob.control      *Auxiliary for Controlling Robust Fitting*

---

## Description

Auxiliary function used for fitting the sample selection models. Contains control sequences, tuning constants and robustness weight functions.

## Usage

```
heckitrob.control(acc = 1e-04, test.acc = "coef", maxit = 50, maxit0 = 50,
                 weights.x1 = c("none", "hat", "robCov", "covMcd"),
                 weights.x2 = c("none", "hat", "robCov", "covMcd"),
                 tcc = 1.345, t.c = 1.345)
```

## Arguments

acc	positive convergence level
test.acc	only "coef" is currently implemented
maxit	integer giving the maximum number of iterations: selection equation
maxit0	integer giving the maximum number of iterations: outcome equation
weights.x1	vector of robustness weights controlling for the leverage effect in the selection equation



weights.x2	vector of robustness weights controlling for the leverage effect in the outcome equation
tcc	tuning constant c for Huber's psi-function for the selection stage
t.c	tuning constant c for Huber's psi-function for the outcome stage

**Value**

A list with the arguments as components.

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

MEPS2001	<i>Ambulatory Expenditures Data</i>
----------	-------------------------------------

---

**Description**

Sample of 3328 observations, with 526 zero expenditures.

**Usage**

data(MEPS2001)

**Format**

A data frame with 3328 observations on the following 22 variables.

educ education status  
age age  
income income  
female gender  
vgood a numeric vector  
good a numeric vector  
hospexp a numeric vector  
totchr number of chronic diseases  
ffs a numeric vector  
dhospexp a numeric vector  
age2 a numeric vector  
agefem a numeric vector  
fairpoor a numeric vector  
year01 a numeric vector  
instype a numeric vector

ambexp ambulatory expenditures  
 lambexp log ambulatory expenditures  
 blhisp ethnicity  
 instype\_s1 a numeric vector  
 dambexp dummy variable, ambulatory expenditures  
 lnambx a numeric vector  
 ins insurance status

### Source

2001 Medical Expenditure Panel Survey by the Agency for Healthcare Research and Quality.

### References

Cameron, C.A. and Trivedi, P.K. (2009) *Microeconometrics Using Stata*, College Station, TX: Stata Press.

### Examples

```

data(MEPS2001)
attach(MEPS2001)
hist(lnambx)

```

---

MmatrM

*M Matrix*

---

### Description

M matrix of a linear regression M-estimator of Mallows type.

### Usage

```
MmatrM(x, y, beta, sigma, t.c = 1.345, weights = 1)
```

### Arguments

x	matrix of explanatory variables
y	vector of dependent variables
beta	vector of parameters
sigma	robust scale estimate
t.c	tuning constant c for Huber's psi-function
weights	vector of robustness weights controlling for the leverage effects

**Details**

Computes the M matrix of the M-estimator of Mallows type. In current implementation only the Huber score function is available.

**Value**

M matrix for the sandwich formula.

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

MROZ.RAW

*Wage Offer Data*

---

**Description**

Sample of 753 observations, with 325 truncated observations.

**Usage**

```
data(MROZ.RAW)
```

**Format**

A data frame with 753 observations on the following 22 variables.

inlf in labor force (binary)

hours hours worked

kidslt6 number of young children

kidsge6 number of children greater than 6 years of age

age age

educ education status

wage wage

repwage a numeric vector

hushrs a numeric vector

husage husband's age

huseduc husband's education

huswage husband's wage

faminc family income

mtr a numeric vector

motheduc mother's education

fatheduc a numeric vector

unem a numeric vector  
 city a numeric vector  
 exper experience  
 nwifeinc non-wife income  
 lwage log-wage  
 expersq squared experience

## References

Mroz , T.A. (1987) The Sensitivity of an Empirical Model of Married Women's Hours of Work to Economic and Statistical Assumptions. *Econometrica*, 55, p. 765-799.  
 Wooldridge, J.M. (2002) *Econometric Analysis of Cross Section and Panel Data*, Cambridge MA: MIT Press.

## Examples

```
data(MROZ.RAW)
attach(MROZ.RAW)
hist(lwage)
```

---

print.etregrob      *Print a etregrob Object*

---

## Description

Print an object generated by [etregrob](#)

## Usage

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

## Arguments

x	object of etregrob class
digits	number of nonzero digits after comma
...	currently not used

## Author(s)

Mikhail Zhelonkin

## See Also

[etregrob](#)

---

print.heckit5rob      *Print a heckit5rob Object*

---

**Description**

Print an object generated by [ssmrob](#)

**Usage**

```
## S3 method for class 'heckit5rob'  
print(x, digits = 4, ...)
```

**Arguments**

x	object returned from the <a href="#">heckit5rob</a> representing the fit of the model
digits	number of nonzero digits after comma
...	currently not used

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[ssmrob](#)

---

print.heckitrob      *Print a heckitrob Object*

---

**Description**

Print an object generated by [ssmrob](#)

**Usage**

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

**Arguments**

x	object returned from the <a href="#">heckitrob</a> representing the fit of the model
digits	number of nonzero digits after comma
...	currently not used

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[ssmrob](#)

---

print.summary.etregrob

*Print Function for summary.etregrob*

---

**Description**

Print a [summary.etregrob](#) object

**Usage**

```
## S3 method for class 'summary.etregrob'  
print(x, digits = 4, ...)
```

**Arguments**

x	Object of class <code>summary.etregrob</code> returned by a summary function
digits	number of nonzero digits after comma
...	currently not used

**Author(s)**

Mikhail Zhelonkin

---

print.summary.heckit5rob

*Print Function for summary.heckit5rob*

---

**Description**

Print a [summary.heckit5rob](#) object

**Usage**

```
## S3 method for class 'summary.heckit5rob'  
print(x, digits = 4, ...)
```

**Arguments**

x	Object of class <code>summary.heckitrob</code> returned by a summary function
digits	number of nonzero digits after comma
...	currently not used

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

print.summary.heckitrob

*Print Function for summary.heckitrob*

---

**Description**

Print a `summary.heckitrob` object

**Usage**

```
## S3 method for class 'summary.heckitrob'
print(x, digits = 4, ...)
```

**Arguments**

x	Object of class <code>summary.heckitrob</code> returned by a summary function
digits	number of nonzero digits after comma
...	currently not used

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

---

PsiMest

*Score Function of the Mallows M-Estimator*

---

**Description**

Score function of the Mallows-type M-estimator.

**Usage**

```
PsiMest(x, y, beta, sigma, t.c, weight)
```

**Arguments**

x	vector of exogenous variables
y	scalar endogenous variable
beta	parameter vector
sigma	std.error
t.c	tuning constant of Huber Psi-function
weight	scalar weight on the exogenous variables

**Details**

Can be used to compute the influence function of the estimator. Also can be used to approximate the bias of the estimator.

**Value**

score of the Psi-function

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**References**

Hampel, Ronchetti, Rousseeuw, Stahel (1986). *Robust Statistics: The Approach Based on Influence Functions*. New York: Wiley.

---

residuals.etregrob     *Residuals of Robust Endogenous Treatment Model Fit*

---

**Description**

Calculate the residuals of the endogenous treatment model using robust fit.

**Usage**

```
## S3 method for class 'etregrob'
residuals(object, ...)
```

**Arguments**

object	object of class "etregrob"
...	currently not used

**Value**

numeric vector of residuals.



**Author(s)**

Mikhail Zhelonkin

**See Also**[etregrob](#)

---

residuals.heckit5rob *Residuals of Robust Sample Selection Model Fit*

---

**Description**

Calculate the residuals of the sample selection model using robust fit.

**Usage**

```
## S3 method for class 'heckit5rob'  
residuals(object, ...)
```

**Arguments**

object	object of class " <a href="#">heckitrob</a> " or object of class " <a href="#">heckit5rob</a> "
...	currently not used

**Details**

In case of truncated selection model one vector of residuals is returned. In case of switching regression model a list containing two vectors corresponding to two regimes is returned.

**Value**

The numeric vector(s) of the residuals.

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**[heckitrob](#); [heckit5rob](#)

---

residuals.heckitrob     *Residuals of Robust Sample Selection Model Fit*

---

**Description**

Calculate the residuals of the sample selection model using robust fit.

**Usage**

```
## S3 method for class 'heckitrob'  
residuals(object, ...)
```

**Arguments**

object	object of class "heckitrob" or object of class "heckit5rob"
...	currently not used

**Details**

In case of truncated selection model one vector of residuals is returned. In case of switching regression model a list containing two vectors corresponding to two regimes is returned.

**Value**

vector(s) of residuals.

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[heckitrob](#); [heckit5rob](#)

---

ssmrob     *Robust Sample Selection Model*

---

**Description**

Compute robust two-stage estimates of truncated selection model (Tobit-2) and switching regression model (Tobit-5).

**Usage**

```
ssmrob(selection, outcome, control = heckitrob.control())
```

**Arguments**

selection	formula, the selection equation
outcome	formula(s), the outcome equation(s)
control	a list of parameters for controlling the fitting process

**Details**

Outcome equation may be a simple formula for the case of Heckman selection model, or a list of two formulas for the case of switching regressions.

**Value**

Object of class "heckitrob" or object of class "heckit5rob".

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**References**

- Amemiya, T. (1984) Tobit Models: a Survey. *Journal of Econometrics*, 24, p. 3-61.
- Heckman, J.J. (1979) Sample Selection Bias as a Specification Error. *Econometrica*, 47, p. 153-161.
- Zhelonkin, M., Genton M.G., and Ronchetti, E. (2016) Robust Inference in Sample Selection Models. *Journal of the Royal Statistical Society, Series B*, 78, p. 805-827.

**See Also**

[heckitrob](#), [heckit5rob](#)

**Examples**

```
# sample selection model (Tobit-2)
# Zhelonkin, Genton, Ronchetti (2016): page 823
data(MEPS2001)
attach(MEPS2001)
selectEq <- dambexp ~ age + female + educ + blhisp + totchr + ins
outcomeEq <- lnambx ~ age + female + educ + blhisp + totchr + ins
meps.fit <- ssmrob(selectEq, outcomeEq, control = heckitrob.control(tcc = 3.2))
summary(meps.fit)

# switching regressions example (Tobit-5)
## Not run:
library(mvtnorm)
set.seed(2)
N <- 5000
beta1 <- c(0, 1.0, 1.0, 0.75)
beta21 <- c(0, 1.5, 1.0, 0.5)
beta22 <- c(1, -1.5, 1.0, 0.5)
```

```

covm <- diag(3)
covm[lower.tri(covm)] <- c(0.75, 0.5, 0.25)
covm[upper.tri(covm)] <- covm[lower.tri(covm)]
eps <- rmvnorm(N, rep(0, 3), covm)
x1 <- rmvnorm(N, mean=c(0, -1, 1), sigma=diag(c(1, 0.5, 1)))
x21 <- x1
x22 <- x1
x21[, 3] <- rnorm(N, 1, 1)
x22[, 3] <- rnorm(N, 1, 1)
x1beta1 <- beta1[1] + x1[, 1]*beta1[2] + x1[, 2]*beta1[3] + x1[, 3]*beta1[4]
x21beta21 <- beta21[1] + x21[, 1]*beta21[2] + x21[, 2]*beta21[3] + x21[, 3]*beta21[4]
x22beta22 <- beta22[1] + x22[, 1]*beta22[2] + x22[, 2]*beta22[3] + x22[, 3]*beta22[4]
y1 <- ifelse(x1beta1 + eps[, 1] > 0, 1, 0)
y2 <- ifelse(y1 > 0.5, x21beta21 + eps[, 2],
x22beta22 + eps[, 3])
srsim.fit <- ssmrob(y1 ~ x1, list(y2 ~ x21, y2 ~ x22),
control = heckitrob.control(weights.x1 = "hat", weights.x2 = "covMcd"))
summary(srsim.fit)

## End(Not run)

```

---

summary.etregrob

*Summarizing Robust Fits of Endogenous Treatment Models*


---

## Description

Summarizes robust fit of endogenous treatment models.

## Usage

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

## Arguments

object	object of class " <a href="#">"etregrob"</a>
...	currently not used

## Value

object of class "["summary.etregrob"](#)"

## Author(s)

Mikhail Zhelonkin

## See Also

[etregrob](#)

---

summary.heckit5rob      *Summarizing Robust Fits of Sample Selection Models*

---

**Description**

Summarize robust fit of Heckman selection model.

**Usage**

```
## S3 method for class 'heckit5rob'  
summary(object, ...)
```

**Arguments**

object	object of class "heckitrob" or "heckit5rob"
...	currently not used

**Value**

object of class "summary.heckitrob" or object of class "summary.heckit5rob"

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[heckitrob](#); [heckit5rob](#); [heck2steprobVcov](#); [heck5twosteprobVcov](#)

---

summary.heckitrob      *Summarizing Robust Fits of Sample Selection Models*

---

**Description**

Summarize robust fit of Heckman selection model.

**Usage**

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

**Arguments**

object	object of class "heckitrob" or "heckit5rob"
...	currently not used

**Value**

object of class "summary.heckitrob" or object of class "summary.heckit5rob"

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[heckitrob](#); [heckit5rob](#); [heck2steprobVcov](#); [heck5twosteprobVcov](#)

---

vcov.eregrob

*Extract Asymptotic Variance Covariance Matrix*

---

**Description**

Extracts the variance covariance matrix of the robust endogenous treatment model fit

**Usage**

```
## S3 method for class 'eregrob'  
vcov(object, ...)
```

**Arguments**

object	object of class " <a href="#">eregrob</a> "
...	currently not used

**Value**

Variance covariance matrix of the second stage. Variance covariance matrix of the selection stage can be extracted using the vcov function for the probit estimator, e.g. `vcov(eregrob.object$stage1)`.

**Author(s)**

Mikhail Zhelonkin

**See Also**

[ereg2steprobVcov](#)

---

vcov.heckit5rob      *Extract Asymptotic Variance Covariance Matrix*

---

**Description**

Extract the variance covariance matrix of the robust sample selection model fit

**Usage**

```
## S3 method for class 'heckit5rob'
vcov(object, ...)
```

**Arguments**

object	object of class " <a href="#">heckitrob</a> " or object of class " <a href="#">heckit5rob</a> "
...	currently not used

**Value**

Variance covariance matrix of the second stage. Variance covariance matrix of the selection stage can be extracted using the vcov function for the probit estimator, e.g. `vcov(heckitrob.object$stage1)`.

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[heck2steprobVcov](#)

---

vcov.heckitrob      *Extract Asymptotic Variance Covariance Matrix*

---

**Description**

Extract the variance covariance matrix of the robust sample selection model fit

**Usage**

```
## S3 method for class 'heckitrob'
vcov(object, ...)
```

**Arguments**

object	object of class " <a href="#">heckitrob</a> " or object of class " <a href="#">heckit5rob</a> "
...	currently not used

**Value**

Variance covariance matrix of the second stage. Variance covariance matrix of the selection stage can be extracted using the `vcov` function for the probit estimator, e.g. `vcov(heckitrob.object$stage1)`.

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[heck2steprobVcov](#)

---

x2weight.covMcd

*Robustness Weights*

---

**Description**

Auxiliary function. Computation of the leverage weights based on robust Mahalanobis distance. For computation of location and scatter the MCD method is used.

**Usage**

```
x2weight.covMcd(xMat)
```

**Arguments**

xMat            matrix of explanatory variables

**Value**

vector of weights

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[cov.rob](#)



---

x2weight.robCov	<i>Robustness Weights</i>
-----------------	---------------------------

---

**Description**

Auxiliary function. Computation of the leverage weights based on robust Mahalanobis distance. For computation of location and scatter the MVE method is used.

**Usage**

```
x2weight.robCov(xMat)
```

**Arguments**

xMat            matrix of explanatory variables

**Value**

vector of weights

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**See Also**

[cov.rob](#)

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