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Robust Estimation and Inference in Sample Selection Models

Description

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

Details

Package: robHeck
Type: Package
Version: 0.2
Date: 2013-09-19
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Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

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References


coef.heckit5rob

See Also

selection

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.heckit5rob  Extract Coefficients from Robust Sample Selection Model

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"
- ...: 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).
### 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

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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

returns the gradient of the inverse Mills ratio

### Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

### References

**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 be also used to compute the influence function of the two-stage estimator.

**Value**

returns the gradient of the inverse Mills ratio

**Author(s)**

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

**References**

Zhelonkin, Genton and Ronchetti (2012)

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**fitted.heckit5rob**

*Fitted Values of Robust Sample Selection Model*

**Description**

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

**Usage**

```r
## 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 two vectors corresponding to two regimes are returned.

Value
vector(s) of fitted values

Author(s)
Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti
Description

Computation of the asymptotic variance matrix of the robust Heckman’s two-stage estimator for truncated selection model, classified as tobit-2 by Amemiya (1984).

Usage

```r
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`: 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

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

```r
hecktwosteprobvcov(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 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


heckit5rob: Robust Heckit Fit: Switching Regressions

Description

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

Usage

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

Arguments

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

Details

Function provides a robust two-stage estimator 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".

Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti
References


See Also

glmrob, rlm, ssmrob, heckitrob, heckitrob.control

Examples

```r
library(mvtnorm)
covm <- diag(3)
covm[lower.tri(covm)] <- c(0.75, 0.5, 0.25)
covm[upper.tri(covm)] <- covm[lower.tri(covm)]
eps <- rmvnorm(1000, rep(0, 3), covm)
x1 <- rnorm(1000)
y1 <- x1 + eps[,1] > 0
x21 <- rnorm(1000)
x22 <- rnorm(1000)
y2=ifelse(y1 > 0.5, x21 + eps[,2], x22 + eps[,3])
summary(heckit5rob(y2 ~ x21, y2 ~ x22, y1 ~ x1))
```

hekitrobytes

Robust Heckit Fit

Description

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

Usage

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

Arguments

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

Details

Function provides a robust two-stage estimator 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".

Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

References


See Also

glmrob, rlm, ssmrob, heckitrob.control, heckit5rob

Examples

data(MEPS2001)
attach(MEPS2001)
selectEq <- dambexp ~ age+female+educ+blhisp+totchr+ins
outcomeEq <- lnambx ~ age+female+educ+blhisp+totchr+ins
summary(heckitrob(outcomeEq,selectEq,control=heckitrob.control(tcc=3.2,weights.x1="robCov")))
Arguments

- **acc**: positive convergence level
- **test.acc**: Only "coef" is currently implemented
- **maxit**: integer giving the maximum number of iterations: selection equation
- **maxito**: integer giving the maximum number of iterations: outcome equation
- **weights.x1**: robustness weights controlling for the leverage effect in the selection equation
- **weights.x2**: 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

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**MEPS2001**

*Ambulatory Expenditures Data*

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
MmatrM  

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: the robust scale estimate
- t.c: tuning constant c for Huber’s psi-function
- weights: robustness weights controlling for the leverage effect

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

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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
References


Examples

data(mroz.raw)
attach(mroz.raw)
hist(lwage)

print.heckit5rob

Print an heckit5rob object

Description

Print an object generated by `ssmrob`

Usage

## S3 method for class 'heckit5rob'
print(x, ...)

Arguments

x object returned from the heckit5rob representing the fit of the model

... 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, ...)

Arguments
x object returned from the heckitrob representing the fit of the model
... currently not used

Author(s)
Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

See Also
ssmrob

print.summary.heckit5rob

Print function for summary.heckit5rob

Description
Print a summary.heckit5rob object

Usage
## S3 method for class 'summary.heckit5rob'
print(x, ...)

print.summary.heckitrob

Arguments

x Object of class summary.heckitrob returned by summary function
...

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, ...)

Arguments

x Object of class summary.heckitrob returned by summary function
...

currently not used

Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

Psimest

Score Function of the Mallows M-Estimators

Description

Score function of the Mallows-type M-estimator.

Usage

Psimest(x, y, beta, sigma, t.c, weight)
residuals.heckit5rob

Arguments

- x  vector of exogenous variables
- y  endogenous variable
- beta  parameter vector
- sigma  std.error
- t.c  tuning constant of Huber psi function
- weight  vector of weights 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

returns the vector of scores

Author(s)

Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

References

Hampel, Ronchetti, Rousseeuw, Stahel (1986)

residuals.heckit5rob  Residuals of Robust Sample Selection Model

Description

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

Usage

```r
## S3 method for class 'heckit5rob'
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 two vectors corresponding to two regimes are returned.
residuals.heckitrob

Value
The numeric vector(s) of the residuals.

Author(s)
Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

See Also
heckitrob; heckit5rob

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 two vectors corresponding to two regimes are returned.

Value
The numeric vector(s) of the residuals.

Author(s)
Mikhail Zhelonkin, Marc G. Genton, Elvezio Ronchetti

See Also
heckitrob; heckit5rob
Description

Function provides the robust two-stage estimators of truncated selection model (Tobit-2) and switching regression model (Tobit-5).

Usage

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

Arguments

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

Details

Outcome equation may be a simple formula for the case of truncated 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


See Also

`heckitrob`, `heckit5rob`
Examples

```r
# sample selection model (Tobit-2)
data(MEPS2001)
attach(MEPS2001)
selectEq <- dambexp ~ age+female+educ+blhisp+totchr+ins
outcomeEq <- lnambx ~ age+female+educ+blhisp+totchr+ins
summary(ssmrob(outcomeEq,selectEq,control=heckitrob.control(tcc=3.2,weights.x1="robCov")))

# switching regressions example (Tobit-5)
library(mvtnorm)
covm <- diag(3)
covm[lower.tri(covm)] <- c(0.75, 0.5, 0.25)
covm[upper.tri(covm)] <- covm[lower.tri(covm)]
eps <- rmvnorm(1000, rep(0, 3), covm)
x1 <- rnorm(1000)
y1 <- x1 + eps[,1] > 0
x21 <- rnorm(1000)
x22 <- rnorm(1000)
y2=ifelse(y1 > 0.5, x21 + eps[,2], x22 + eps[,3])
summary(ssmrob(list(y2 ~ x21, y2 ~ x22), y1 ~ x1))
```

Description

The `summary.heckit5rob` method summarizes robust fits of Heckman selection models.

Usage

```r
## 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
The summary method summarizes robust fits of Heckman selection models.

Usage

```r
## 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.heckit5rob

Extract Asymptotic Variance Covariance Matrix

Description
Function extracts the variance covariance matrix of the robust sample selection model

Usage

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

Arguments

- `object`: object of class "heckitrob" or object of class "heckit5rob"
- `...`: 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
Robustness weights computation

**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**

```r
xRweight.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

---

Robustness weights computation

**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**

```r
xRweight.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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