Package: brtobit (via r-universe)

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Title Bias-Reduced Tobit Regression

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Depends R (>= 3.6.0)

Imports stats, crch, sandwich

Suggests distributions3, memisc

Description Tobit models are regression models with a Gaussian response variable left-censored at zero, constant latent variance, and a latent mean that depends on covariates through a linear predictor. As an alternative to plain maximum likelihood estimation, the adjusted score equations of Kosmidis and Firth (2010) <doi:10.1214/10-ejs579> are utilized to obtain bias-reduced estimates of the model parameters.

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brtobit *Bias-Reduced Tobit Regression*

Description

Fitting tobit regression models with bias-reduced estimation (rather than plain maximum likelihood).

Usage

```
brtobit(formula, data, subset, na.action,
  model = TRUE, y = TRUE, x = FALSE,
  control = brtobit_control(...), ...)

brtobit_fit(x, y, control = brtobit_control())

brtobit_control(fsmaxit = 100, start = NULL, epsilon = 1e-08, type = "BR", ...)
```

Arguments

formula	a formula expression of the form y ~ x1 + x2 where y is the response and x1 and x2 are regressor variables for the location of the latent Gaussian distribution.
data	an optional data frame containing the variables occurring in the formulas.
subset	an optional vector specifying a subset of observations to be used for fitting.
na.action	a function which indicates what should happen when the data contain NAs.
model	logical. If TRUE *model frame* is included as a component of the returned value.
x, y	for brtobit: logical. If TRUE the model matrix and response vector used for fitting are returned as components of the returned value. For brtobit_fit: x is a design matrix with regressors for the location and y is a vector of observations.
...	arguments to be used to form the default control argument if it is not supplied directly.
control, fsmaxit, start, epsilon	a list of control parameters passed for the Fisher scoring optimization.
type	character. Should bias-reduced (BR) or plain maximum likelihood (ML) estimation be used?

Details

brtobit fits tobit regression models with bias-reduced (BR) estimation as introduced by Köll et al. (2021). The model assumes an underlying latent Gaussian variable:

$$y_i^* \sim \mathcal{N}(\mu_i, \sigma^2)$$

which is only observed if positive and zero otherwise: $y_i = \max(0, y_i^*)$. The latent mean μ_i is linked to a linear predictor

$$\mu_i = x_i^\top \beta$$

and the latent variance σ^2 is assumed to be constant.

`brtobit_fit` is the lower level function where the actual fitting takes place.

A set of standard extractor functions for fitted model objects is available for objects of class `"brtobit"`, including methods to the generic functions `print`, `summary`, `coef`, `vcov`, `logLik`, `predict`, `model.frame`, `model.matrix`, `bread` (from the **sandwich** package), `getSummary` (from the **memisc** package, enabling `mtable`), and `prodist` (from the **distributions3** package, enabling various methods and graphics from the **topmodels** packages).

In the future we intend to extend the implementation to heteroscedastic tobit models in the `crch` package (Messner, Mayr, Zeileis 2016).

Value

`brtobit` returns an object of class `"brtobit"`, i.e., a list with components as follows. `brtobit_fit` returns an unclassed list with components up to `converged`.

`coefficients`	vector of estimated regression coefficients (plus the variance),
`bias`	bias estimate,
`vcov`	covariance matrix of all parameters in the model,
`loglik`	the log-likelihood of the fitted model,
`df`	number of estimated parameters,
`nobs`	number of observations,
`grad`	gradient vector,
`control`	list of control parameters,
`iterations`	number of iterations,
`converged`	logical indicating whether the Fisher scoring optimization converged,
`call`	the original function call,
`formula`	the original formula,
`terms`	terms objects for the model,
`levels`	levels of the categorical regressors,
`contrasts`	contrasts corresponding to `levels` from the respective models,
`model`	the full model frame (if `model = TRUE`),
`y`	the numeric response vector (if `y = TRUE`),
`x`	model matrix (if `x = TRUE`).

References

Köll S, Kosmidis I, Kleiber C, Zeileis A (2021). "Bias Reduction as a Remedy to the Consequences of Infinite Estimates in Poisson and Tobit Regression." arXiv:2101.07141, arXiv.org E-Print Archive. https://arxiv.org/abs/2101.07141

Messner JW, Mayr GJ, Zeileis A (2016). Heteroscedastic Censored and Truncated Regression with crch. *The R Journal*, **8**(1), 173–181. https://journal.R-project.org/archive/2016-1/messner-mayr-zeileis.pdf.

See Also

crch

Examples

```
## artificial data generating process from Koell et al. (2021)
dgp <- function(n = 100, coef = c(1, 1, -10, 2), prob = 0.25) {
  x2 <- runif(n, -1, 1)
  x3 <- rbinom(n, size = 1, prob = ifelse(x2 > 0, prob, 1 - prob))
  y <- rnorm(n, mean = coef[1] + coef[2] * x2 + coef[3] * x3, sd = sqrt(coef[4]))
  y[y <= 0] <- 0
  data.frame(y, x2, x3)
}

set.seed(2020-10-29)
d <- dgp()

## models
m22_ml <- brtobit(y ~ x2 + x3, data = d, type = "ML", fsmaxit = 28)
m22_br <- brtobit(y ~ x2 + x3, data = d, type = "BR")
m2_all <- brtobit(y ~ x2, data = d, type = "ML")
m2_sub <- update(m2_all, subset = x3 == 0)

if(require("memisc")) {

## Table 2
mtable("ML" = m22_ml, "BR" = m22_br, "ML/sub" = m2_sub, "ML/SST" = m2_all,
  summary.stats = c("Log-likelihood", "N"))

}
```

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