Package ‘OrthoPanels’

May 4, 2021

Title Dynamic Panel Models with Orthogonal Reparameterization of Fixed Effects

Version 1.1-4

Description Implements the orthogonal reparameterization approach recommended by Lancaster (2002) to estimate dynamic panel models with fixed effects (and optionally: panel specific intercepts). The approach uses a likelihood-based estimator and produces estimates that are asymptotically unbiased as N goes to infinity, with a T as low as 2.

Depends R (>= 3.1.0)

Imports MASS

Suggests testthat, knitr, rmarkdown

License GPL (>= 3)

LazyData true

VignetteBuilder knitr

RoxygenNote 6.1.1

NeedsCompilation no

Maintainer Mark Pickup <mark.pickup@sfu.ca>

Author Davor Cubranic [aut],
Mark Pickup [aut, cre],
Paul Gustafson [aut],
Geoffrey Evans [aut],
Jonoska Stojkova Biljana [ctb]

Repository CRAN

Date/Publication 2021-05-04 04:40:10 UTC

R topics documented:

OrthoPanels-package ........................................... 2
abond_panel .................................................... 3
BES_panel ..................................................... 4
OrthoPanels-package

OrthoPanels: Orthogonalized Panel Model

Description

This package includes the function `opm()`, which implements the orthogonal reparameterization approach recommended by Lancaster (2002) to estimate dynamic panel models with fixed effects (and optionally: panel specific intercepts). The OLS estimator for such models is biased with a fixed (small) $N$ (Nickell 1981). Equivalently, a maximum likelihood estimation leads to an incidental parameters problem (Neyman and Scott 1948; Lancaster 2000). The approach by Lancaster (2002) uses an orthogonal reparameterization of the fixed effects to produce a likelihood-based estimator of the remaining parameters that is exact and consistent as $N$ approaches infinity for $T$ greater than or equal to 2.

Details

Orthopanels can accomodate unbalanced panel data, in that some respondents may drop out early (attrition) and some respondents may enter the panel late (refreshment). It is assumed that once respondents enter the panel, they will have observations up until they dropout and then NAs in subsequent waves. The estimation is conducted under the assumption that the data is missing at random.

References


Description

The dynamics of labour demand of firm id in the United Kingdom in year year as a function of real product wages, gross capital stock and industry output. This is done using the data used by Arellano and Bond (1991).

Format

A data frame with 813 rows and 16 variables

Details

A survey of 1845 respondents using 3 waves of panel survey data from the 2010 British Election Study. The variables are as follows:

- id case number
- year time wave
- n log of employment in firm id at time year
- w natural log of the real product wage
- k natural log of gross capital stock
- ys natural log of industry output
- l_w lag of w
- l_k lag of k
- l2_k two-step lag of k
- l_ys lag of ys
- l2_ys two-step lag of ys
- yr1980..yr1984 time dummies

References

BES_panel  Responses from the 2010 British Election Study

Description

A survey of 1845 respondents using 3 waves of panel survey data from the 2010 British Election Study. The variables are as follows:

Format

A data frame with 5535 rows and 11 variables

Details

- n case number
- t time wave
- Econ Assessment of change in the national economic situation over the past 12 months (1-5, 1='got a lot worse’, 5='got a lot better’)
- Clegg Evaluation of Liberal Party leader Nick Clegg (0-10, 0='strongly dislike’ and 10='strongly like’)
- Brown Evaluation of Labour Party leader Gordon Brown
- Cameron Evaluation of Conservative Party leader David Cameron
- Approve Approval of the government, as expressed by feeling about the ruling Labour Party (0-10, 0='strongly dislike’, 10='strongly like’)
- NHS Assesment of the current government’s handling of the National Health Service (1-5, 1='very badly’, 5='very well’)
- Terror Assesment of the current government’s handling of terrorism (1-5, 1='very badly’, 5='very well’)
- PID Personal identification with the Labour Party (0/1, 0='no’, 1='yes’)
- Tax Preference for policy on taxes and health and social spending (0-10, 0='cut taxes a lot and spend much less’, 10='increase taxes a lot and spend much more’)

caterplot  Caterpillar Plots of opm Model Parameters

Description

Creates side-by-side plots of equal-tailed credible intervals of opm model parameters. The intervals are displayed as horizontal lines, with 90% interval using a thicker line width and 95% interval a thinner one. The posterior median is indicated with a dot.
Usage

caterplot(x, parm, main = paste("Caterpillar plot of", xname),
  xlab = "Range of parameter samples", labels = colnames(ranges))

Arguments

   x                        an instance of class opm
parm                       a specification of which parameters are to be plotted, either a vector of names
                           ("rho", "sig2" and "beta" are the only legal values) or a vector of positional
                           indices. If missing, all parameters are considered.
main, xlab                 useful defaults for the plot title and X-axis label
labels                     labels for each parameter's interval: see axis

Value

   A matrix of 2.5%, 5%, 50%, 95%, and 97.5% quantiles for each of the desired parameters, with
   parameters arranged in columns.

Examples

   ## Not run:
caterplot(o, main = NULL, labels = expression(alpha, beta, sigma^2))

   ## End(Not run)

---

confint.opm

Credible Intervals for Model Parameters

Description

   Computes equal-tailed credible intervals for one or more parameters in a fitted opm model. The
   method used is the quantile interval of the posterior sample.

Usage

   ## S3 method for class 'opm'
   confint(object, parm, level = 0.95, ...)

Arguments

   object                        an instance of class opm whose credible intervals are wanted
parm                           a specification of which parameters are to be given credible intervals, either a
                               vector of names ("rho", "sig2", and "beta" are the only legal values) or a vector
                               of positional indices. If missing, all parameters are considered.
level                           the size of the interval (e.g., 0.95 for 95% C.I.)
...                             additional argument(s) for methods
DIC

Description

Computes the Deviance Information Criterion (DIC), which is a generalization of the Akaike Information Criterion. Models with smaller DIC are considered to fit better than models with larger DIC.

Usage

DIC(object, ...)

Arguments

object

an instance of class opm whose DIC is wanted.

... further arguments passed to other methods.

Details

DIC is defined as \( DIC = 2 \cdot \bar{D} - D_\theta \) where:
\[
\bar{D} = -2 \cdot \text{mean}(\log\text{-likelihood at parameters samples})
\]
\[
D_\theta = -2 \cdot \log(\text{likelihood at expected value of parameters})
\]

DIC is calculated as:

\[2 \cdot (-2 \cdot \text{mean}(\log\text{-likelihood at each element of parameter samples}))
-(-2 \cdot \log(\text{likelihood at mean parameter sample value}))\]

Value

a numeric value with the corresponding DIC

Note

Note the speed of computation of the DIC in proportional to the number of sampled values of the parameters in the opm object.
Description

Method for `hist` applied to `opm` objects. Each parameter will be plotted in a separate figure.

Usage

```r
## S3 method for class 'opm'
hist(x, parm, ask = dev.interactive(), plot = TRUE,
    main = NULL, xlab = NULL, ...)
```

Arguments

- `x`: an instance of class `opm`
- `parm`: a specification of which parameters are to be plotted, either a vector of names ("rho", "sig2" and "beta" are the only legal values) or a vector of positional indices. If missing, all parameters are considered.
- `ask`: if "TRUE", and the R session is interactive, the user is asked to press a key before a new figure (i.e., histogram of the next model parameter) is drawn.
- `plot`: if "TRUE" (default), the resulting object of class "histogram" is plotted by `plot.hist`
- `main, xlab`: (optional) vector of titles and X-axis labels for each figure.
- `...`: further arguments passed to the `hist` function operating on the individual parameter's samples

Value

A list of objects of class "histogram", one for each requested model parameter. The elements are named after the parameter.
Usage

```r
opm(x, ...)  
```

## Default S3 method:
```r
opm(x, y, n.samp, add.time.indicators = FALSE, ...)
```

## S3 method for class 'formula'
```r
opm(x, data = environment(x), subset = NULL,  
    index = 1:2, n.samp, ...)
```

Arguments

- **x**: a formula (see description of parameter formula below) or an array of dimension time x variable x case of terms.
- **y**: a matrix of dimensions time x case of responses.
- **n.samp**: number of samples to use to estimate the parameters.
- **add.time.indicators**: (logical) if TRUE, adds dummy variables for time.
- **data**: an optional data frame, list, or environment containing the variables in the model. If not found in data, the variables are taken from `environment(x)`, typically the environment from which `opm` is called.
- **subset**: an optional vector specifying a subset of observations to be used in the fitting process.
- **index**: a two-element vector containing the index of the case and time variables, respectively. Variable indices can be specified by name or position. This argument is ignored if the model is not specified by the formula, because the index is implicit in the organization of the terms and response arrays.

Details

The model can be either specified symbolically with the formula `response ~ term1 + term2 ...` or with the terms and response given as a pair of 3- and 2-dimensional arrays, `x` and `y` respectively. The arrays have to be in the format time x variable x case for terms and time x case for the response.

The lagged dependent variable does not need to be included in the formula or data, as it is included automatically.

Value

An object of class `opm` with the following elements:

- **samples**: parameter samples used to estimate the model, as a list with following elements:
  - `rho`: a vector of `n.samp` samples of `ρ`.
  - `v`: a vector of `n.samp` samples of $\frac{1}{\sigma^2}$.
  - `beta`: an `n.samp x variable` matrix of samples of `β`. 
The function `summary` (i.e., `summary.opm`) can be used to obtain or print a summary of the results. The generic accessor functions `coefficients`, `fitted.values`, `residuals`, `logLik`, and `df.residual` can be used to extract various useful features of the value returned by `opm`.

**Note**

Dummy time variables exist as an additional column for each wave of data, excluding the first and second wave (i.e., at $t = 0$ and $t = 1$ using the terminology from Lancaster (2000)). The new variables are named `tind.t`, where $t = 2, ..., $ and appear as such as elements of the estimated beta coefficient.

**Examples**

```r
set.seed(123)
N <- 5
T <- 2
beta <- .5
rho <- .5
v <- 1

f <- runif(N, -2, 2)
K <- length(beta)
beta <- matrix(beta, K, 1)

## $x_i = 0.75 f + N(0, 1)$:
x <- array(.75*f, dim=c(N, K, (T+1))) + rnorm(N*K*(T+1))

## $y_{i,t} = \rho y_{i,t-1} + \beta x_{i,t} + f_i + N(0,1)$:
y <- matrix(0, N, T+1)
for (t in seq_len(T+1)) {
  yy <- if (t>1) y[,t-1] else 0
  y[,t] <- rho * yy + f + x[,,t] %*% beta + rnorm(N, sd = sqrt(1/v))
}

d <- data.frame(i = rep(seq(N), T+1),
                 t = rep(seq(T+1), each = N),
                 as.data.frame(matrix(aperm(x, c(1, 3, 2)), N*(T+1), K),
                               dimnames = list(NULL, paste0('x', seq(K))))),
                 y = c(y))

opm(y~x1, d, n.samp = 10)
```
plot.opm

Plot Method for an opm Object

Description

Method for plot applied to opm objects. Each parameter will be plotted as a density plot in a separate figure.

Usage

## S3 method for class 'opm'
plot(x, parm, ask = dev.interactive(), main = NULL, xlab = NULL, ...)

Arguments

x an instance of class opm

parm a specification of which parameters are to be plotted, either a vector of names ("rho", "sig2" and "beta" are the only legal values) or a vector of positional indices. If missing, all parameters are considered.

ask if "TRUE", and the R session is interactive, the user is asked to press a key before a new figure (i.e., histogram of the next model parameter) is drawn.

main, xlab (optional) vector of titles and X-axis labels for each figure.

... further arguments passed to the plot function operating on the individual parameter's samples

Value

A list of objects of class "density", one for each requested model parameter. The elements are named after the parameter.

p_rho

Returns the posterior density $p(\rho|\Theta)$

Description

Returns the posterior density $p(\rho|\Theta)$

Usage

p_rho(x, y, rho, log.p = FALSE)
Arguments

- **x**: an array of dimension time x variable x case of terms.
- **y**: a matrix of dimension time x case of responses.
- **rho**: vector of quantiles.
- **log.p**: if TRUE, probabilities are given as log(p).

### Description

Produces quantiles of the posterior samples corresponding to the given probabilities. In other words, it is equivalent to computing "quantile(x,...)", where "x" is the original Monte Carlo sample of the parameter “parm”, as produced by `opm`.

### Usage

```r
## S3 method for class 'opm'
quantile(x, parm, ...)
```

### Arguments

- **x**: an instance of class `opm` whose sample quantiles are wanted
- **parm**: a specification of which parameters are to be given quantiles, either a vector of names ("rho", "sig2", and "beta" are the only legal values) or a vector of positional indices. If missing, all parameters are considered.
- **...**: further arguments passed to the `quantile` function operating on the individual parameter’s samples

### Value

A matrix of quantiles for each of the desired parameters, with parameters arranged in columns. If arguments include "names = FALSE", the quantile labels won’t be included (i.e., the rownames of the matrix will be NULL).

### See Also

`quantile`
Index

abond_panel, 3
axis, 5

BES_panel, 4
caterplot, 4
confint, 6
confint.opm, 5

DIC, 6

hist, 7
hist.opm, 7

opm, 7, 7, 10, 11
OrthoPanels-package, 2

p_rho, 10
plot, 10
plot.opm, 10

quantile, 11
quantile.opm, 11