Package 'xtife'

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Type Package

Title Interactive Fixed Effects Estimator for Balanced Panel Data

Version 0.1.3

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Description Implements the interactive fixed effects ('IFE') panel estimator of Bai (2009) <doi:10.3982/ECTA6135> with analytical standard errors ('homoskedastic', 'HC1' robust, and cluster-robust by unit). Supports asymptotic bias correction for large panels (Bai 2009) and a dynamic extension for predetermined regressors (Moon and Weidner 2017 <doi:10.1017/S0266466615000328>). Includes information-criterion-based factor number selection (Bai and Ng 2002 <doi:10.1111/1468-0262.00273>). All computations use base R only with no external dependencies.

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Encoding UTF-8

Language en-US

LazyData true

RoxygenNote 7.3.3

Depends R (>= 3.5.0)

Imports stats

Suggests testthat (>= 3.0.0), knitr, rmarkdown

VignetteBuilder knitr

URL https://github.com/Rickchen0910/xtife

BugReports https://github.com/Rickchen0910/xtife/issues

NeedsCompilation no

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Repository CRAN

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Contents

`cigar` *Dataset on US Cigarette Demand Panel*

Description

Balanced panel of cigarette sales and prices across 46 US states for 30 years (1963–1992). Originally used in Baltagi (1995) and widely used as a benchmark dataset for panel estimators.

Usage

```
cigar
```

Format

A data frame with 1,380 rows and 9 variables:

state US state identifier (integer, 1–46)

year year (integer, 1963–1992)

price cigarette price index

pop state population

pop16 population aged 16 and over

cpi consumer price index

ndi per-capita disposable income

sales per-capita cigarette sales (packs per person per year)

pimin minimum cigarette price in adjoining states

Source

Baltagi, B.H. (1995) *Econometric Analysis of Panel Data*. Wiley. Distributed with the **plm** R package (Croissant and Millo 2008).

References

Baltagi, B.H. (1995). *Econometric Analysis of Panel Data*. Wiley.

Croissant, Y. and Millo, G. (2008). Panel data econometrics in R: the plm package. *Journal of Statistical Software*, 27(2), 1–43. doi:10.18637/jss.v027.i02

`ife` *Estimate Interactive Fixed Effects Model (Bai 2009)*

Description

Fits the panel model

$$y_{it} = \alpha_i + \xi_t + X'_{it}\beta + \lambda'_i F_t + u_{it}$$

for balanced panel data with analytical standard errors.

Usage

```
ife(
  formula,
  data,
  index,
  r = 1L,
  force = "two-way",
  se = "standard",
  bias_corr = FALSE,
  method = "static",
  M1 = 1L,
  tol = 1e-09,
  max_iter = 10000L
)
```

Arguments

`formula`	R formula: `outcome ~ covariate1 + covariate2 + ...`
`data`	data.frame in long format (one row per unit-time observation)
`index`	character(2): `c("unit_id_column", "time_id_column")`
`r`	integer >= 0, number of interactive factors (default 1)
`force`	additive FE specification: `"none"` | `"unit"` | `"time"` | `"two-way"` (default `"two-way"`)
`se`	SE type: `"standard"` | `"robust"` | `"cluster"` (default `"standard"`; `"cluster"` clusters by unit id)
`bias_corr`	logical; if `TRUE` apply bias correction. For `method = "static"` uses the two-term Bai (2009) Sec. 7 correction (B/N + C/T). For `method = "dynamic"` uses the three-term Moon and Weidner (2017) correction (B1/T + B2/N + B3/T). Requires r > 0 and at least one covariate. (default `FALSE`)
`method`	`"static"` (default) for Bai (2009) strictly-exogenous regressors; `"dynamic"` for Moon and Weidner (2017) predetermined regressors (e.g. lagged dependent variable). The dynamic estimator uses double projection M_Lambda M_F on X in the SVD loop.
`M1`	integer; lag bandwidth for the B1 dynamic bias term (default `1L`). Only used when `method = "dynamic"` and `bias_corr = TRUE`.
`tol`	convergence tolerance (default `1e-9`)
`max_iter`	maximum iterations (default `10000L`)

Value

An S3 object of class `"ife"` with the following components:

- `coef` – named p-vector of estimated coefficients
- `vcov` – p x p variance-covariance matrix
- `se` – named p-vector of standard errors
- `tstat` – named p-vector of t-statistics
- `pval` – named p-vector of two-sided p-values
- `ci` – p x 2 matrix of 95% confidence intervals (CI.lower, CI.upper)
- `table` – data.frame coefficient table (Estimate, Std.Error, t.value, Pr.t, CI.lower, CI.upper)
- `F_hat` – T x r estimated factor matrix
- `Lambda_hat` – N x r estimated loading matrix
- `residuals` – T x N residual matrix (full model)
- `sigma2` – estimated error variance
- `df` – residual degrees of freedom
- `n_iter` – iterations to convergence
- `converged` – logical
- `N`, `T`, `r`, `force`, `se_type` – model dimensions and options
- `call` – matched call

References

Bai, J. (2009). Panel data models with interactive fixed effects. *Econometrica*, 77(4), 1229–1279. doi:10.3982/ECTA6135

Moon, H.R. and Weidner, M. (2017). Dynamic linear panel regression models with interactive fixed effects. *Econometric Theory*, 33, 158–195. doi:10.1017/S0266466615000328

Bai, J. and Ng, S. (2002). Determining the number of factors in approximate factor models. *Econometrica*, 70(1), 191–221. doi:10.1111/14680262.00273

Examples

```
data(cigar, package = "xtife")
fit <- ife(sales ~ price, data = cigar, index = c("state", "year"),
           r = 2, force = "two-way", se = "standard")
print(fit)
```

`ife_select_r` *Select the Number of Factors via Information Criteria*

Description

Fits the IFE model for r = 0, 1, ..., `r_max` and evaluates five information criteria at each value of r. Returns IC1, IC2, and IC3 from Bai and Ng (2002) Proposition 1, applied to IFE residuals per Bai (2009) Section 9.4, plus a BIC-style penalty (`IC_bic`) and a small-sample-corrected prediction criterion (`PC`) from Bai (2009). The criterion-minimising r for each IC is flagged with `"*"` in the printed table, and a data-driven recommendation (favouring `IC_bic` when the Bai-Ng criteria decrease monotonically) is displayed.

Usage

```
ife_select_r(
  formula,
  data,
  index,
  r_max = NULL,
  force = "two-way",
  verbose = TRUE,
  tol = 1e-09,
  max_iter = 10000L
)
```

Arguments

`formula`	R formula passed to `ife()`
`data`	long-format data.frame
`index`	character(2): `c("unit_id", "time_id")`
`r_max`	maximum r to consider (default: `min(8, floor(min(N,T)/2))`)
`force`	additive FE type (default `"two-way"`)
`verbose`	logical; if `TRUE` (default) print progress and results table to the console. Set to `FALSE` for silent operation.
`tol`	convergence tolerance (default `1e-9`)
`max_iter`	maximum iterations (default `10000L`)

Value

(invisibly) a data.frame with columns `r`, `V_r`, `IC1`, `IC2`, `IC3`, `IC_bic`, `PC`, `converged`, and attribute `"suggested"` (named integer vector giving the IC-minimising r for each criterion).

References

Bai, J. (2009). Panel data models with interactive fixed effects. *Econometrica*, 77(4), 1229–1279. doi:10.3982/ECTA6135

Bai, J. and Ng, S. (2002). Determining the number of factors in approximate factor models. *Econometrica*, 70(1), 191–221. doi:10.1111/14680262.00273

Examples

```
data(cigar, package = "xtife")
sel <- ife_select_r(sales ~ price, data = cigar,
                    index = c("state", "year"), r_max = 4)
```

`print.ife` *Print an IFE Model Summary*

Description

Prints a formatted summary of an object of class `"ife"`, including panel dimensions, number of factors, additive fixed effect specification, SE type, and a coefficient table with standard errors, t-statistics, p-values, and 95% confidence intervals. If bias correction was applied, bias terms are also reported. Information criteria are printed when the object contains them (i.e., when called from `ife_select_r()`).

Usage

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

Arguments

`x`	an object of class `"ife"`
`digits`	number of significant digits (default 4)
`...`	unused

Value

`x` invisibly.

Examples

```
data(cigar, package = "xtife")
fit <- ife(sales ~ price, data = cigar, index = c("state", "year"),
           r = 2, force = "two-way", se = "standard")
print(fit)
```

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