

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](https://doi.org/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](https://doi.org/10.1017/S0266466615000328)>). Includes information-criterion-based factor number selection (Bai and Ng 2002 <[doi:10.1111/1468-0262.00273](https://doi.org/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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cigar	<i>Dataset on US Cigarette Demand Panel</i>
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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 $r = 0, 1, \dots, r_{\max}$ 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: $\min(8, \text{floor}(\min(N, T)/2))$)
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

<code>x</code>	an object of class "ife"
<code>digits</code>	number of significant digits (default 4)
<code>...</code>	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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