Package 'bife'

May 7, 2026

Type Package

Title Binary Choice Models with Fixed Effects

Version 0.7.3

Description Estimates fixed effects binary choice models (logit and probit) with potentially many individual fixed effects and computes average partial effects. Incidental parameter bias can be reduced with an asymptotic bias correction proposed by Fernandez-Val (2009) <doi:10.1016/j.jeconom.2009.02.007>.

License GPL (>= 2)

Depends R (>= 3.1.0)

Imports data.table, Formula, Rcpp, stats

LinkingTo Rcpp, RcppArmadillo

URL https://github.com/amrei-stammann/bife

BugReports https://github.com/amrei-stammann/bife/issues

RoxygenNote 7.3.3

LazyData true

Suggests alpaca, knitr, rmarkdown

VignetteBuilder knitr

Encoding UTF-8

NeedsCompilation yes

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Repository CRAN

Date/Publication 2025-10-27 08:30:02 UTC

Contents

`bias_corr` *Asymptotic bias correction for binary choice Models with fixed effects*

Description

`bias_corr` is a post-estimation routine that can be used to substantially reduce the incidental parameter bias problem (Neyman and Scott (1948)) present in non-linear fixed effects models (see Fernández-Val and Weidner (2018) for an overview). The command applies the analytical bias correction derived by Fernández-Val (2009) to obtain bias-corrected estimates of the structural parameters.

Remark: Fernández-Val (2009) further refined the bias correction of Hahn and Newey (2004). The correction is now also applicable to models with weakly exogenous regressors.

Usage

```
bias_corr(object, L = 0L)
```

Arguments

`object`	an object of class `"bife"`.
`L`	unsigned integer indicating a bandwidth for the estimation of spectral densities proposed by Hahn and Kuersteiner (2011). Default is zero, which should be used if all regressors are assumed to be strictly exogenous. In the presence of weakly exogenous or predetermined regressors, Fernández-Val and Weidner (2018) suggest to choose a bandwidth not higher than four.

Value

The function bias_corr returns a named list of class "bife".

References

Fernández-Val, I. (2009). "Fixed effects estimation of structural parameters and marginal effects in panel probit models". Journal of Econometrics 150(1), 71-85.

Fernández-Val, I. and M. Weidner (2018). "Fixed effects estimation of large-t panel data models". Annual Review of Economics, 10, 109-138.

Hahn, J. and G. Kuersteiner (2011). "Bias reduction for dynamic nonlinear panel models with fixed effects". Econometric Theory, 27(6), 1152-1191.

Hahn, J. and W. Newey (2004). "Jackknife and analytical bias reduction for nonlinear panel models". Econometrica 72(4), 1295-1319.

Neyman, J. and E. L. Scott (1948). "Consistent estimates based on partially consistent observations". Econometrica, 16(1), 1-32.

Stammann, A., F. Heiss, and D. McFadden (2016). "Estimating Fixed Effects Logit Models with Large Panel Data". Working paper.

See Also

bife

Examples

```
# Load 'psid' dataset
library(bife)
dataset <- psid

# Fit a static logit model
mod <- bife(LFP ~ I(AGE^2) + log(INCH) + KID1 + KID2 + KID3 + factor(TIME) | ID, dataset)
summary(mod)

# Apply analytical bias correction
mod_bc <- bias_corr(mod)
summary(mod_bc)
```

---

bife *Efficiently fit binary choice models with fixed effects*

Description

bife can be used to fit fixed effects binary choice models (logit and probit) based on an unconditional maximum likelihood approach. It is tailored for the fast estimation of binary choice models with potentially many individual fixed effects. The routine is based on a special pseudo demeaning

algorithm derived by Stammann, Heiss, and McFadden (2016). The estimates obtained are identical to the ones of glm, but the computation time of bife is much lower.

Remark: The term fixed effect is used in econometrician's sense of having a full set of individual specific intercepts. All other parameters in the model are referred to as structural parameters.

Usage

```
bife(
  formula,
  data = list(),
  model = c("logit", "probit"),
  beta_start = NULL,
  control = list(),
  bias_corr = NULL,
  tol_demeaning = NULL,
  iter_demeaning = NULL,
  tol_offset = NULL,
  iter_offset = NULL
)
```

Arguments

formula	an object of class "formula" (or one that can be coerced to that class): a symbolic description of the model to be fitted. formula must be of type $y\ x\|id$ where the id refers to an individual identifier (fixed effect category).
data	an object of class "data.frame" containing the variables in the model.
model	the description of the error distribution and link function to be used in the model. For bife this has to be a character string naming the model function. Default is "logit".
beta_start	an optional vector of starting values used for the structural parameters in the optimization algorithm. Default is zero for all structural parameters.
control	a named list of parameters for controlling the fitting process. See bife_control for details.
bias_corr	deprecated; see bias_corr.
tol_demeaning, iter_demeaning, tol_offset, iter_offset	deprecated; see bife_control.

Details

bife drops all observations of cross-sectional units (individuals) with non-varying response. This can de done because these observations do not contribute to the identification of the structural parameters (perfect classification).

If bife does not converge this is usually a sign of linear dependence between one or more regressors and the fixed effects. In this case, you should carefully inspect your model specification.

Value

The function bife returns a named list of class "bife".

References

Stammann, A., F. Heiss, and D. McFadden (2016). "Estimating Fixed Effects Logit Models with Large Panel Data". Working paper.

Examples

```
# Load 'psid' dataset
library(bife)
dataset <- psid

# Fit a static logit model
mod <- bife(LFP ~ I(AGE^2) + log(INCH) + KID1 + KID2 + KID3 + factor(TIME) | ID, dataset)
summary(mod)
```

`bife_control` *Set* `bife` *Control Parameters*

Description

Set and change parameters used for fitting `bife`.

Usage

```
bife_control(
  dev_tol = 1e-08,
  iter_max = 25L,
  trace = FALSE,
  rho_tol = NULL,
  conv_tol = NULL
)
```

Arguments

`dev_tol`	tolerance level for the first stopping condition of the maximization routine. The stopping condition is based on the relative change of the deviance in iteration r and can be expressed as follows: $\|dev_r - dev_{r-1}\|/(0.1 + \|dev_r\|) < tol$. Default is `1.0e-08`.
`iter_max`	unsigned integer indicating the maximum number of iterations in the maximization routine. Default is `25L`.
`trace`	logical indicating if output should be produced in each iteration. Default is `FALSE`.
`conv_tol, rho_tol`	deprecated; step-halving is now similar to `glm.fit2`.

Value

The function `bife_control` returns a named list of control parameters.

See Also

bife

---

coef.bife *Extract estimates of structural parameters or fixed effects*

Description

coef.bife is a generic function which extracts estimates of the structural parameters or fixed effects from objects returned by bife.

Usage

```
## S3 method for class 'bife'
coef(object, type = c("sp", "fe"), corrected = NULL, fixed = NULL, ...)
```

Arguments

object	an object of class "bife".
type	the type of parameter estimates that should be returned; structural parameters or fixed effects. Default is "sp" referring to the structural parameters.
corrected, fixed	deprecated.
...	other arguments.

Value

The function coef.bife returns a named vector of estimates of the requested parameters.

See Also

bife

---

coef.bifeAPEs *Extract estimates of average partial effects*

Description

coef.bifeAPEs is a generic function which extracts estimates of the average partial effects from objects returned by get_APEs.

Usage

```
## S3 method for class 'bifeAPEs'
coef(object, ...)
```

Arguments

`object`	an object of class `"APEs"`.
`...`	other arguments.

Value

The function `coef.bifeAPEs` returns a named vector of estimates of the average partial effects.

See Also

`get_APEs`

`fitted.bife` *Extract* `bife` *fitted values*

Description

`fitted.bife` is a generic function which extracts fitted values from an object returned by `bife`.

Usage

```
## S3 method for class 'bife'
fitted(object, ...)
```

Arguments

`object`	an object of class `"bife"`.
`...`	other arguments.

Value

The function `fitted.bife` returns a vector of fitted values.

See Also

`bife`

get_APEs *Compute average partial effects for binary choice models with fixed effects*

Description

get_APEs is a post-estimation routine that can be used to estimate average partial effects with respect to all covariates in the model and the corresponding covariance matrix. The estimation of the covariance is based on a linear approximation (delta method). Note that the command automatically determines which of the regressors are continuous or binary.

Remark: The routine currently does not allow to compute average partial effects based on functional forms like interactions and polynomials.

Note: apeff_bife is deprecated and will be removed soon.

Usage

```
get_APEs(
  object,
  n_pop = NULL,
  sampling_fe = c("independence", "unrestricted"),
  weak_exo = FALSE
)

apeff_bife(...)
```

Arguments

object	an object of class "bife".
n_pop	unsigned integer indicating a finite population correction for the estimation of the covariance matrix of the average partial effects proposed by Cruz-Gonzalez, Fernández-Val, and Weidner (2017). The correction factor is computed as follows: $(n^* - n)/(n^* - 1)$, where n^* and n are the size of the entire population and the full sample size. Default is NULL, which refers to a factor of zero and a covariance obtained by the delta method.
sampling_fe	a string equal to "independence" or "unrestricted" which imposes sampling assumptions about the unobserved effects. "independence" imposes that all unobserved effects are mutually independent sequences. "unrestricted" does not impose any sampling assumptions. Note that this option only affects the optional finite population correction. Default is "independence".
weak_exo	logical indicating if some of the regressors are assumed to be weakly exogenous (e.g. predetermined). If object is returned by bias_corr, the option will be automatically set to TRUE if the chosen bandwidth parameter is larger than zero. Note that this option only affects the estimation of the covariance matrix. Default is FALSE, which assumes that all regressors are strictly exogenous.
...	arguments passed to the deprecated function apeff_bife.

Value

The function get_APEs returns a named list of class "bifeAPEs".

References

Cruz-Gonzalez, M., I. Fernández-Val, and M. Weidner. (2017). "Bias corrections for probit and logit models with two-way fixed effects". The Stata Journal, 17(3), 517-545.

Fernández-Val, I. (2009). "Fixed effects estimation of structural parameters and marginal effects in panel probit models". Journal of Econometrics 150(1), 71-85.

Fernández-Val, I. and M. Weidner (2018). "Fixed effects estimation of large-t panel data models". Annual Review of Economics, 10, 109-138.

Neyman, J. and E. L. Scott (1948). "Consistent estimates based on partially consistent observations". Econometrica, 16(1), 1-32.

Stammann, A., F. Heiss, and D. McFadden (2016). "Estimating Fixed Effects Logit Models with Large Panel Data". Working paper.

See Also

bias_corr, bife

Examples

```
# Load 'psid' dataset
library(bife)
dataset <- psid

# Fit a static logit model
mod <- bife(LFP ~ I(AGE^2) + log(INCH) + KID1 + KID2 + KID3 + factor(TIME) | ID, dataset)
summary(mod)

# Compute average partial effects
mod_ape <- get_APEs(mod)
summary(mod_ape)

# Apply analytical bias correction
mod_bc <- bias_corr(mod)
summary(mod_bc)

# Compute bias-corrected average partial effects
mod_ape_bc <- get_APEs(mod_bc)
summary(mod_ape_bc)
```

logLik.bife *Extract log-likelihood*

Description

logLik.bife extracts the sum of the log-likelihood from an object returned by bife.

Usage

```
## S3 method for class 'bife'
logLik(object, ...)
```

Arguments

object	an object of class "bife".
...	other arguments.

Value

The function logLik.bife returns the sum of the log-likelihood.

See Also

bife

predict.bife *Predict method for* bife *fits*

Description

predict.bife is a generic function which obtains predictions from an object returned by bife.

Usage

```
## S3 method for class 'bife'
predict(
  object,
  type = c("link", "response"),
  X_new = NULL,
  alpha_new = NULL,
  corrected = NULL,
  ...
)
```

Arguments

object	an object of class "bife".
type	the type of prediction required. "link" is on the scale of the linear predictor whereas "response" is on the scale of the response variable. Default is "link".
X_new	a data.frame or a regressor matrix for predictions. If not supplied predictions are based on the regressor matrix returned by the object bife. See Details.
alpha_new	a scalar or vector of fixed effects. If not supplied predictions are based on the vector of fixed effects returned by bife or the average. See Details.
corrected	deprecated.
...	other arguments

Details

The model frame returned by the object bife only includes individuals that were not dropped before the fitting process (due to perfect classification). The linear predictors of perfectly classified observations are equal to -Inf or Inf whereas the predicted probabilities are equal to their response. In-sample predictions are only based on non-perfectly classified observations.

If alpha_new is supplied as a scalar the linear predictor is computed using the same value of the fixed effect for each observation. If alpha_new is supplied as a vector it has to be of same length as the rows of the corresponding regressor matrix. If only X_new is provided but not alpha_new, we use the average.

Value

The function predict.bife returns a vector of predictions.

See Also

bife

---

print.bife *Print* bife

Description

print.bife is a generic function which displays some minimal information from objects returned by bife.

Usage

```
## S3 method for class 'bife'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

x	an object of class "bife".
digits	unsigned integer indicating the number of decimal places. Default is max(3L, getOption("digits") - 3L).
...	other arguments.

See Also

bife

---

print.bifeAPEs *Print* bifeAPEs

Description

print.bifeAPEs is a generic function which displays some minimal information from objects returned by get_APEs.

Usage

```
## S3 method for class 'bifeAPEs'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

x	an object of class "bifeAPEs".
digits	unsigned integer indicating the number of decimal places. Default is max(3L, getOption("digits") - 3L).
...	other arguments.

See Also

get_APEs

print.summary.bife *Print* summary.bife

Description

print.summary.bife is a generic function which displays summary statistics from objects returned by summary.bife.

Usage

```
## S3 method for class 'summary.bife'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

x	an object of class "summary.bife".
digits	unsigned integer indicating the number of decimal places. Default is max(3L, getOption("digits") - 3L).
...	other arguments.

See Also

bife

print.summary.bifeAPEs *Print* summary.bifeAPEs

Description

print.summary.bifeAPEs is a generic function which displays summary statistics from objects returned by summary.bifeAPEs.

Usage

```
## S3 method for class 'summary.bifeAPEs'
print(x, digits = max(3L, getOption("digits") - 3L), ...)
```

Arguments

x	an object of class "summary.bifeAPEs".
digits	unsigned integer indicating the number of decimal places. Default is max(3L, getOption("digits") - 3L).
...	other arguments.

See Also

get_APEs

---

psid *Female labor force participation*

Description

The sample was obtained from the "Panel Study of Income Dynamics" and contains information about $N = 1461$ women that were observed over $T = 9$ years.

Usage

```
psid
```

Format

A data frame with 13,149 rows:

ID individual identifier

LFP labor force participation

KID1 # of kids aged between 0 and 2

KID2 # of kids aged between 3 and 5

KID3 # of kids aged between 6 and 17

INCH income husband

AGE age of woman

TIME time identifier

References

Hyslop, D. (1999). "State Dependence, Serial Correlation and Heterogeneity in Intertemporal Labor Force Participation of Married Women". Econometrica 67(6), 1255-1294.

Fernandez-Val, I. (2009). "Fixed effects estimation of structural parameters and marginal effects in panel probit models". Journal of Econometrics 150(1), 71-85.

See Also

bife

summary.bife *Summarizing models of class* bife

Description

Summary statistics for objects of class "bife".

Usage

```
## S3 method for class 'bife'
summary(object, type = c("sp", "fe"), corrected = NULL, fixed = NULL, ...)
```

Arguments

object	an object of class "bife".
type	the type of parameter estimates the summary statistics are related to: structural parameters or fixed effects. Default is "sp" referring to the structural parameters.
corrected, fixed	deprecated.
...	other arguments.

Value

Returns an object of class "summary.bife" which is a list of summary statistics of object.

See Also

bife

summary.bifeAPEs *Summarizing models of class* bifeAPEs

Description

Summary statistics for objects of class "bifeAPEs".

Usage

```
## S3 method for class 'bifeAPEs'
summary(object, ...)
```

Arguments

object	an object of class "bifeAPEs".
...	other arguments.

Value

Returns an object of class "summary.bifeAPEs" which is a list of summary statistics of object.

See Also

get_APEs

---

vcov.bife *Extract estimates of the covariance matrix*

Description

vcov.bife computes an estimate of the covariance matrix of the estimator of the structural parameters from objects returned by bife. The estimate is obtained using the inverse of the negative Hessian after convergence.

Usage

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

Arguments

object	an object of class "bife".
...	other arguments.

Value

The function vcov.bife returns a named matrix of covariance estimates.

See Also

bife

`vcov.bifeAPEs` *Extract estimates of the covariance matrix*

Description

`vcov.bifeAPEs` computes an estimate of the covariance matrix of the estimator of the average partial parameters from objects returned by `get_APEs`.

Usage

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

Arguments

`object`	an object of class "`bifeAPEs`".
`...`	other arguments.

Value

The function `vcov.bifeAPEs` returns a named matrix of covariance estimates.

See Also

`get_APEs`

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