

Package ‘bife’

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Type Package

Title Binary Choice Models with Fixed Effects

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Date 2018-03-03

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 a bias-correction proposed by Hahn and Newey (2004) <doi:10.1111/j.1468-0262.2004.00533.x>.

License GPL (>= 2)

Depends R (>= 3.1.0)

Imports Rcpp (>= 0.12.14), Formula, stats

LinkingTo Rcpp, RcppArmadillo

RoxygenNote 6.0.1

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VignetteBuilder knitr

NeedsCompilation yes

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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 a bias-correction proposed by Hahn and Newey (2004) <doi:10.1111/j.1468-0262.2004.00533.x>.

Details

The DESCRIPTION file:

```

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Version:     0.5
Date:       2018-03-03
Authors@R:   c(person("Amrei", "Stammann", email = "amrei.stammann@hhu.de", role = c("aut", "cre")), person("D
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Suggests:  ggplot2, knitr, rmarkdown, survival
VignetteBuilder: knitr
NeedsCompilation: yes
Author:     Amrei Stammann [aut, cre], Daniel Czarnowske [aut], Florian Heiss [aut], Daniel McFadden [ctb]
Maintainer: Amrei Stammann <amrei.stammann@hhu.de>

```

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References

- Hahn, J., and W. Newey (2004). "Jackknife and analytical bias reduction for nonlinear panel models." *Econometrica* 72(4), 1295-1319.
- Stammann, A., F. Heiss, and D. McFadden (2016). "Estimating Fixed Effects Logit Models with Large Panel Data". Working paper.

acs	<i>Female labor force participation - "American Community Survey (ACS PUMS 2014)"</i>
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Description

The sample is drawn from the American Community Survey (ACS PUMS 2014) were the panel structure is slightly different in comparison to the "classic" structure. Overall 662,775 married women in $N = 51$ states were observed. Since each state is of different population size, this results in a highly unbalanced panel were the largest state consists of $T_{max} = 74,752$ and the smallest of $T_{min} = 855$ married women.

Usage

acs

Format

A data frame with 662,775 rows:

ST state identifier

AGEP age of woman

FER indicates if a woman gave birth to a child within the past 12 months

PINCP total persons income

LFP labor force participation

References

American Community Survey. <https://www.census.gov>.

See Also

[bife](#)

apeff_bife

Average Partial Effects for Binary Choice Models with Fixed Effects

Description

apeff_bife is a function used to compute average partial effects for fixed effects binary choice models. It is able to compute bias-corrected average partial effects derived by Newey and Hahn (2004) to account for the incidental parameters bias.

Usage

```
apeff_bife(mod, discrete = NULL, bias_corr = "ana", iter_demeaning = 100,
           tol_demeaning = 1e-05, iter_offset = 1000, tol_offset = 1e-05)
```

Arguments

mod	an object of class bife.
discrete	a description of the variables that are discrete regressors. For apeff_bife this has to be a character string naming the discrete regressors. Default is NULL (no discrete regressor(s)).
bias_corr	an optional string that specifies the type of the bias correction: semi or analytical. The value should be any of the values "semi" or "ana". Default is "ana" (analytical bias-correction). Details are given under Details.
iter_demeaning	an optional integer value that specifies the maximum number of iterations of the demeaning algorithm. Default is 100. Details are given under Details.
tol_demeaning	an optional number that specifies the tolerance level of the demeaning algorithm. Default is 1e-5. Details are given under Details.

<code>iter_offset</code>	an optional integer value that specifies the maximum number of iterations of the offset algorithm for the computation of bias-adjusted fixed effects. Default is 1000. Details are given under <code>Details</code> .
<code>tol_offset</code>	an optional number that specifies the tolerance level of the offset algorithm for the computation of bias-adjusted fixed effects. Default is 1e-5. Details are given under <code>Details</code> .

Details

The semi bias-corrected average partial effects are computed as usual partial effects with the bias-adjusted fixed effects and the bias-corrected structural parameters.

The analytical bias-corrected average partial effects follow Newey and Hahn (2004). For further details consult the description of `bife`.

Note: Bias-corrected partial effects can be only returned if the object `mod` returns bias-corrected coefficients, i.e. if a bias-correction has been used in the previous `bife` command.

Value

An object of `apeff_bife` returns a named matrix with at least a first column "apeff" containing the uncorrected average partial effects of the structural variables. An optional second column "apeff_corrected" is returned containing the corrected average partial effects of the structural variables.

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

References

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

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

See Also

[bife](#)

Examples

```
library("bife")

# Load 'psid' dataset
dataset <- psid
head(dataset)

# Fixed effects logit model w/o bias-correction
mod_no <- bife(LFP ~ AGE + I(INCH / 1000) + KID1 + KID2 + KID3 | ID,
  data = dataset, bias_corr = "no")
```

```

# Compute uncorrected average partial effects for mod_no
# Note: bias_corr does not affect the result
apeff_bife(mod_no, discrete = c("KID1", "KID2", "KID3"))

# Fixed effects logit model with analytical bias-correction
mod_ana <- bife(LFP ~ AGE + I(INCH / 1000) + KID1 + KID2 + KID3 | ID,
  data = dataset)

# Compute semi-corrected average partial effects for mod_ana
apeff_bife(mod_ana, discrete = c("KID1", "KID2", "KID3"),
  bias_corr = "semi")

# Compute analytical bias-corrected average partial effects
# for mod_ana
apeff_bife(mod_ana, discrete = c("KID1", "KID2", "KID3"))

```

bife

Binary Choice Models with Fixed Effects

Description

bife is used to fit fixed effects binary choice models (logit and probit) based on an unconditional likelihood approach. It is tailored for the fast estimation of binary choice models with potentially many individual fixed effects. The large dummy variable matrix is avoided by a special iteratively reweighted least squares demeaning algorithm (Stammann, Heiss, and McFadden, 2016). The incidental parameter bias occurring in panels with shorter time horizons can be reduced by analytical bias-correction (Newey and Hahn, 2004). If no bias-correction is applied, the estimated coefficients will be identical to the ones obtained by glm. However, bife will compute faster than glm, if the model exhibits many fixed effects.

Remark: The term fixed effect is used in econometrician's sense of having a time-constant dummy for each individual. All other parameters in the model are referred to as structural parameters.

Usage

```

bife(formula, data = list(), beta_start = NULL, model = "logit",
  bias_corr = "ana", iter_demeaning = 100L, tol_demeaning = 1e-05,
  iter_offset = 1000L, tol_offset = 1e-05)

```

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 $y \sim x id$ where the id refers to an individual identifier (fixed effects).
data	an optional data frame, list or environment (or object coercible by as.data.frame to a data frame) containing the variables in the model.
beta_start	an optional vector of starting values used for the structural parameters in the demeaning algorithm. Default is zero for all structural parameters.

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. The value should be any of "logit" or "probit". Default is "logit".
bias_corr	an optional string that specifies the type of the bias-correction: no bias-correction or analytical. The value should be any of "no" or "ana". Default is "ana" (analytical).
iter_demeaning	an optional integer value that specifies the maximum number of iterations of the demeaning algorithm. Default is 100. Details are given under Details.
tol_demeaning	an optional number that specifies the tolerance level of the demeaning algorithm. Default is 1e-5. Details are given under Details.
iter_offset	an optional integer value that specifies the maximum number of iterations of the offset algorithm for the computation of bias-adjusted fixed effects. Default is 1000. Details are given under Details.
tol_offset	an optional number that specifies the tolerance level of the offset algorithm for the computation of bias-adjusted fixed effects. Default is 1e-5. Details are given under Details.

Details

A typical predictor has the form *response terms|id* where response is the binary response vector (0-1 coded), terms is a series of terms which specifies a linear predictor for the response, and refers to an individual identifier. The linear predictor must not include any constant regressors due to the perfect collinearity with the fixed effects. Since individuals with a non-varying response do not contribute to the log likelihood they are dropped from the estimation procedure (unlike g1m). The analytical bias-correction follows Newey and Hahn (2004).

Details for iter_demeaning and tol_demeaning: A special iteratively reweighted least squares demeaning algorithm is used following Stammann, A., F. Heiss, and D. McFadden (2016). The stopping criterion is defined as $||b(i) - b(i - 1)|| < tol_{demeaning}$.

Details for iter_offset and tol_offset: The bias-adjusted fixed effects are computed via an iteratively reweighted least (IWLS) squares algorithm efficiently tailored to sparse data. The algorithm includes the bias-corrected structural parameters in the linear predictor during fitting. The stopping criterion in the IWLS algorithm is defined as $any(|b(i) - b(i - 1)|/|b(i - 1)|) < tol_{offset}$.

Value

An object of class bife is a list containing the following components:

par	
\$beta	a vector of the uncorrected structural parameters
\$alpha	a vector of the uncorrected fixed effects
\$se_beta	a vector of the standard errors of the uncorrected structural parameters
\$se_alpha	a vector of the standard errors of the uncorrected fixed effects
\$beta_vcov	a matrix of the covariance matrix of the uncorrected structural parameters
\$avg_alpha	the average of the uncorrected fixed effects
par_corr	

<code>\$beta</code>	a vector of the bias-corrected structural parameters
<code>\$alpha</code>	a vector of the bias-adjusted fixed effects
<code>\$se_beta</code>	a vector of the standard errors of the bias-corrected structural parameters
<code>\$se_alpha</code>	a vector of the standard errors of the bias-adjusted fixed effects
<code>\$beta_vcov</code>	a matrix of the covariance matrix of the bias-corrected structural parameters
<code>\$avg_alpha</code>	the average of the bias-adjusted fixed effects
<code>logl_info</code>	
<code>\$nobs</code>	number of observations
<code>\$k</code>	number of loglikelihood parameters
<code>\$loglik</code>	the log likelihood value given the uncorrected parameters
<code>\$events</code>	number of events
<code>\$iter_demeaning</code>	the number of iterations of the demeaning algorithm
<code>\$conv_demeaning</code>	a logical value indicating convergence of the demeaning algorithm
<code>\$loglik_corr</code>	the log likelihood given the bias-corrected/-adjusted parameters
<code>\$iter_offset</code>	the number of iterations of the offset algorithm
<code>\$conv_offset</code>	a logical value indicating convergence of the offset algorithm
<code>model_info</code>	
<code>\$used_ids</code>	a vector of the retained ids during fitting
<code>\$y</code>	the response vector given <code>\$used_ids</code>
<code>\$beta_start</code>	a vector of used starting values
<code>\$X</code>	the model matrix given <code>\$used_ids</code>
<code>\$id</code>	a vector of the individual identifier given <code>\$used_ids</code>
<code>\$t</code>	a vector of the time identifier given <code>\$used_ids</code>
<code>\$drop_pc</code>	number of individuals dropped during fitting due to non-varying response (perfect classification)
<code>\$drop_NA</code>	number of individuals dropped due to missing values
<code>...</code>	further objects passed to other methods in <code>bife</code>

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

References

- Hahn, J., and W. Newey (2004). "Jackknife and analytical bias reduction for nonlinear panel models". *Econometrica* 72(4), 1295-1319.
- Stammann, A., F. Heiss, and D. McFadden (2016). "Estimating Fixed Effects Logit Models with Large Panel Data". Working paper.

Examples

```
library("bife")

# Load 'psid' dataset
dataset <- psid
head(dataset)

# Fixed effects logit model w/o bias-correction
mod_no <- bife(LFP ~ AGE + I(INCH / 1000) + KID1 + KID2 + KID3 | ID,
  data = dataset, bias_corr = "no")

# Summary of uncorrected structural parameters only
summary(mod_no)

# Summary plus fixed effects
summary(mod_no, fixed = TRUE)

# Fixed effects logit model with analytical bias-correction
mod_ana <- bife(LFP ~ AGE + I(INCH / 1000) + KID1 + KID2 + KID3 | ID,
  data = dataset)

# Summary of bias-corrected structural parameters only
summary(mod_ana)

# Summary of uncorrected structural parameters only
summary(mod_ana, corrected = FALSE)

# Summary of bias-corrected structural parameters plus -adjusted
# fixed effects
summary(mod_ana, fixed = TRUE)

# Extract bias-corrected structural parameters of mod_ana
beta_ana <- coef(mod_ana)
print(beta_ana)

# Extract bias-adjusted fixed effects of mod_ana
alpha_ana <- coef(mod_ana, fixed = TRUE)
print(alpha_ana)

# Extract uncorrected structural parameters of mod_ana
beta_no <- coef(mod_ana, corrected = FALSE)
print(beta_no)

# Extract covariance matrix of bias-corrected structural
# parameters of mod_ana
vcov_ana <- vcov(mod_ana)
print(vcov_ana)

# Extract covariance matrix of uncorrected structural parameters
# of mod_ana
vcov_no <- vcov(mod_ana, corrected = FALSE)
print(vcov_no)
```

`coef.bife`*Extract Model Coefficients*

Description

`coef.bife` is a generic function which extracts model coefficients from objects returned by `bife`.

Usage

```
## S3 method for class 'bife'  
coef(object, corrected = TRUE, fixed = FALSE, ...)
```

Arguments

<code>object</code>	an object of class <code>bife</code> .
<code>corrected</code>	an optional logical flag that specifies whether bias-corrected or uncorrected coefficients are displayed. Default is <code>TRUE</code> (bias-corrected).
<code>fixed</code>	an optional logical flag that specifies whether the structural parameters or the fixed effects are displayed. Default is <code>FALSE</code> (structural parameters).
<code>...</code>	other arguments

Value

The function `coef.bife` returns a named vector of coefficients.

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

See Also

[bife](#)

predict.bife *Computes Predicted Probabilities*

Description

Returns the predicted probabilities of an object returned by bife.

Usage

```
## S3 method for class 'bife'  
predict(object, X_new = NULL, alpha_new = NULL,  
        corrected = TRUE, ...)
```

Arguments

object	an object of class bife.
X_new	a regressor matrix for predictions. If not supplied predictions are based on the 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. See Details.
corrected	an optional logical flag that specifies whether the predicted probabilities are based on the bias-corrected/-adjusted parameters. Default is TRUE (bias-corrected).
...	other arguments

Details

The regressor matrix returned by the object bife only includes individuals that were not dropped during fitting due to a non-varying response (perfect classification). The predicted probabilities of those observations are equal to their response.

If alpha_new is supplied as a scalar each predicted probability is computed with the same fixed effect. If alpha_new is supplied as a vector it has to be of same dimension as the corresponding regressor matrix.

Value

The function predict.bife returns a (named) vector of predicted probabilities.

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

See Also

[bife](#)

Examples

```

library("bife")

# Load 'psid' dataset
dataset <- psid
head(dataset)

# Fixed effects logit model w/o bias-correction
mod_no <- bife(LFP ~ AGE + I(INCH / 1000) + KID1 + KID2 + KID3 | ID,
  data = dataset, bias_corr = "no")

# Compute predicted probabilities based on the regressor matrix
# and fixed effects stored in 'mod_no'
prob <- predict(mod_no)

# Compute predicted probabilities based on the regressor matrix
# and all fixed effects set to zero
prob_zero <- predict(mod_no, alpha_new = 0.0)

```

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(3, getOption("digits") - 3), ...)

```

Arguments

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

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

See Also

[bife](#)

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(3, getOption("digits") - 3), ...)
```

Arguments

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

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

See Also

[bife](#)

psid *Female labor force participation - "Panel Study of Income Dynamics"*

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 0-2

KID2 # of kids 3-5

KID3 # of kids 6-17

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.

See Also

[bife](#)

results_acs

Results "American Community Survey"

Description

Results reported in the vignette.

Usage

results_acs

Format

A named matrix with 4 rows and 4 columns.

See Also

[bife](#)

results_psid	<i>Results "Panel Study of Income Dynamics"</i>
--------------	---

Description

Results reported in the vignette.

Usage

```
results_psid
```

Format

A named matrix with 6 rows and 4 columns.

See Also

[bife](#)

summary.bife	<i>Summarizing Binary Choice Models with Fixed Effects</i>
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Description

Summary statistics for objects of class bife.

Usage

```
## S3 method for class 'bife'
summary(object, corrected = TRUE, fixed = FALSE, ...)
```

Arguments

object	an object of class bife.
corrected	an optional logical flag that specifies whether bias-corrected or uncorrected coefficients are displayed. Default is TRUE (bias-corrected).
fixed	an optional logical flag that specifies whether only structural parameters or all coefficients (structural parameters and fixed effects) are displayed. Default is FALSE (only structural parameters).
...	other arguments

Value

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

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

See Also

[bife](#)

time_n

Computation time with varying N

Description

Results reported in the vignette.

Usage

time_n

Format

A named matrix with 10 rows and 4 columns.

See Also

[bife](#)

time_t

Computation time with varying T

Description

Results reported in the vignette.

Usage

time_t

Format

A named matrix with 10 rows and 4 columns.

See Also

[bife](#)

`vcov.bife`*Extract Covariance Matrix of Structural Parameters*

Description

`vcov.bife` extracts the covariance matrix of the structural parameters from objects returned by `bife`

Usage

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

Arguments

<code>object</code>	an object of class <code>bife</code> .
<code>corrected</code>	an optional logical flag that specifies whether the covariance matrix of the bias-corrected or uncorrected structural parameters are displayed. Default is <code>TRUE</code> (bias-corrected).
<code>...</code>	other arguments

Value

The function `vcov.bife` returns a named covariance matrix of the structural parameters.

Author(s)

Amrei Stammann, Daniel Czarnowske, Florian Heiss, Daniel McFadden

See Also

[bife](#)

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