Package 'bife'

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Type Package

Title Binary Choice Models with Fixed Effects

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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>.

License GPL (>= 2)

Depends R (>= 2.10)

Imports Rcpp (>= 0.12.5), Formula, stats

LinkingTo Rcpp, RcppArmadillo

SystemRequirements C++11

RoxygenNote 5.0.1

LazyData true

Suggests knitr, rmarkdown, survival, ggplot2

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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`bife-package` *Binary Choice Models with Fixed Effects*

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Details

The DESCRIPTION file:

Package:	bife
Type:	Package
Title:	Binary Choice Models with Fixed Effects
Version:	0.1
Date:	2016-07-28
Authors@R:	c(person("Amrei", "Stammann", email = "amrei.stammann@hhu.de", role = c("aut", "cre")), person("
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Suggests:	knitr, rmarkdown, survival, ggplot2
VignetteBuilder:	knitr
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.

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acs *Female labor force participation - "American Community Survey (ACS PUMS 2014)"*

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. http://www.census.gov.

See Also

bife

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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, bias.corr = "semi", 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.
bias.corr	an optional string that specifies the type of the bias correction: semi, analytical, jackknife. The value should be any of the values "semi", "ana", or "jack". Default is "semi" (semi 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.

`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

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 depending on which bias-correction (analytical or jackknife) has been used in the previously conducted `bife` command, i.e. which kind of bias-corrected coefficients are stored in the object `mod`.

The analytical and jackknife bias-corrected average partial effects follow Newey and Hahn (2004). The jackknife bias-correction requires to repeatedly calling `bife` (IWLS demeaning algorithm) and to estimate the fixed effects model on a subset of the data where the t-th period is excluded. 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 (analytical or jackknife) 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 given the choosen bias-correction (semi, analytical, or jackknife).

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
data.set <- psid
```

```
head(data.set)

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

# Compute semi-corrected average partial effects for mod.ana
apeff.bife(mod.ana, discrete = c("KID1", "KID2", "KID3"))

# Compute analytical bias-corrected average partial effects
# for mod.ana
apeff.bife(mod.ana, discrete = c("KID1", "KID2", "KID3"),
 bias.corr = "ana")
```

`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 trap is avoided by a special iteratively reweighted least squares demeaning algorithm (Stammann, Heiss, and McFadden, 2016). The incidental parameter bias occuring in panels with shorter time horizons can be reduced by analytic or jackknife 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 = 100, tol.demeaning = 1e-05,
  iter.offset = 1000, 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 $y\ x|id$ where the `id` refers to an individual identifier.

`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, analytical, jackknife. The value should be any of `"no"`, `"ana"`, or `"jack"`. 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 glm). The analytical and jackknife bias-correction follow 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.vcoc`	a matrix of the covariance matrix of the uncorrected structural parameters
`$avg.alpha`	the average of the uncorrected fixed effects
`par.corr`	
`$beta`	a vector of the bias-corrected structural parameters
`$alpha`	a vector of the bias-adjusted fixed effects
`$se.beta`	a vector of the standard errors of the bias-corrected structural parameters
`$se.alpha`	a vector of the standard errors of the bias-adjusted fixed effects
`$beta.vcoc`	a matrix of the covariance matrix of the bias-corrected structural parameters
`$avg.alpha`	the average of the bias-adjusted fixed effects
`logl.info`	
`$nobs`	number of observations
`$df`	degrees of freedom
`$loglik`	the log likelihood value given the uncorrected parameters
`$events`	number of events
`$iter.demeaning`	the number of iterations of the demeaning algorithm
`$conv.demeaning`	a logical value indicating convergence of the demeaning algorithm
`$loklik.corr`	the log likelihood given the bias-corrected/-adjusted parameters
`$iter.offset`	the number of iterations of the offset algorithm
`$conv.offset`	a logical value indicating convergence of the offset algorithm
`model.info`	
`$used.ids`	a vector of the retained ids during fitting
`$y`	the response vector given $used.ids
`$beta.start`	a vector of used starting values
`$X`	the model matrix given $used.ids
`$id`	a vector of the individual identifier given $used.ids
`$t`	a vector of the time identifier given $used.ids
`$drop.pc`	number of individuals dropped during fitting due to non-varying response (perfect classification)
`$drop.NA`	number of individuals dropped due to missing values
`...`	further objects passed to other methods in `bife`

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
data.set <- psid
head(data.set)

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

# 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

`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 the structural parameters or the fixed effects are displayed. Default is `FALSE` (structural parameters).
`...`	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`

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

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 *Results "Panel Study of Income Dynamics"*

Description

Results reported in the vignette.

Usage

```
results.psid
```

Format

A named matrix with 6 rows and 4 columns.

See Also

bife

summary.bife *Summarizing Binary Choice Models with Fixed Effects*

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 paramters from objects returned by bife

Usage

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

Arguments

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