Package ‘ib’

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Type Package

Title Bias Correction via Iterative Bootstrap

Version 0.1.0

Description An implementation of the iterative bootstrap procedure of
procedure has better bias correction properties than the
bootstrap bias correction technique.

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VGAM

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BugReports https://github.com/SMAC-Group/ib/issues/

NeedsCompilation no

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**Description**

Method for generating parametric bootstrap estimates from a fitted model.

**Usage**

```r
bootstrap(object, B = 1000, extra_param = FALSE, ...)
```

**Arguments**

- `object` an object representing a fitted model (see 'Details').
- `B` an integer for number of bootstrap replicates (default 1,000).
- `extra_param` if TRUE, bootstrap is also performed for extra parameters (see 'Details').
- `...` additional optional arguments to pass to `ibControl`.

**Parametric bootstrap**
Details
This method is a simple wrapper around the \texttt{ib} method where number of iterations is set to 1.

Value
A matrix \( p \) (size of parameter) times \( B \) of bootstrapped estimates.

Author(s)
Samuel Orso

See Also
\texttt{ib, ibControl}

Examples

```r
## bootstrap poisson regression
counts <- c(18,17,15,20,10,20,25,13,12)
outcome <- gl(3,1,9)
treatment <- gl(3,3)
pois_fit <- glm(counts ~ outcome + treatment, family = poisson())

## make 100 paramtric bootstrap replicates
boot_dist <- bootstrap(pois_fit, B = 100)
```

 coef, \texttt{Ib}-method

\textit{Method for extracting coefficients from an object in class union "Ib"}

Description
Method for extracting coefficients from an object in class union "Ib"

Usage

```r
## S4 method for signature 'Ib'
coef(object, ...)
```

Arguments

- \texttt{object} an object of class union "Ib"
- \texttt{...} further arguments to pass to \texttt{coef}

See Also
\texttt{ib, coef}
### effects,Ib-method

**Method for extracting effects from an object in class union "Ib"**

**Description**

Method for extracting effects from an object in class union "Ib"

**Usage**

```r
## S4 method for signature 'Ib'
effects(object, ...)  
```

**Arguments**

- `object`: an object of class union "Ib"
- `...`: further arguments to pass to effects

**See Also**

- `Ib`, `effects`

---

### fitted,Ib-method

**Method for extracting fitted values from an object in class union "Ib"**

**Description**

Method for extracting fitted values from an object in class union "Ib"

**Usage**

```r
## S4 method for signature 'Ib'
fitted(object, ...)  
```

**Arguments**

- `object`: an object of class union "Ib"
- `...`: further arguments to pass to fitted

**See Also**

- `Ib`, `fitted.values`
**getEst**

Accessor to the object in class union "Ib"

**Description**

Method for obtaining estimates from fitted model within any object of class union Ib.

**Usage**

```r
ggetEst(x)
```

```r
## S4 method for signature 'Ib'
ggetEst(x)
```

**Arguments**

- `x` an object of class union "Ib"

**See Also**

- `Ib`

---

**getExtra**

Accessor to an extra part in class union "Ib"

**Description**

Method for obtaining extra values generated by the iterative bootstrap procedure within any object of class union Ib.

**Usage**

```r
ggetExtra(x)
```

```r
## S4 method for signature 'Ib'
ggetExtra(x)
```

**Arguments**

- `x` an object of class union "Ib"

**See Also**

- `Ib`
getObject

Accessor to the object in class union "Ib"

Description
Method for obtaining a fitted model within any object of class union Ib.

Usage
getObject(x)

Arguments
x an object of class union "Ib"

See Also
Ib

ib
Bias correction via iterative bootstrap

Description
ib is used to correct the bias of a fitted model object with the iterative bootstrap procedure.

Usage
ib(object, thetastart = NULL, control = list(...), extra_param = FALSE, ...)

## S4 method for signature 'glm'
ib(object, thetastart = NULL, control = list(...), extra_param = FALSE, ...)

## S4 method for signature 'lm'
ib(object, thetastart = NULL, control = list(...), extra_param = FALSE, ...)

## S4 method for signature 'lmerMod'
ib(object, thetastart = NULL, control = list(...), extra_param = FALSE, ...)

## S4 method for signature 'nls'
ib(object, thetastart = NULL, control = list(...), extra_param = FALSE, ...)

## S4 method for signature 'vglm'
ib(object, thetastart = NULL, control = list(...), extra_param = FALSE, ...)
Arguments

object

an object representing a fitted model (see 'Details').

thetastart

an optional starting value for the iterative procedure. If NULL (default), the procedure starts at the estimates in object.

control

a list of parameters for controlling the iterative procedure (see ibControl).

extra_param

if TRUE, the bias of estimation of extra parameters is performed (see 'Details').

... additional optional arguments (see 'Details').

Details

The iterative bootstrap procedure is described in Kuk (1995) and further studied by Guerrier et al. (2019) and Guerrier et al. (2020). The $k$th iteration of this algorithm is

$$
\hat{\theta}^k = \hat{\theta}^{k-1} + \frac{1}{H} \sum_{h=1}^{H} \hat{\pi}_h (\hat{\theta}^{k-1})
$$

for $k = 1, 2, \ldots$ and where the sum is over $h = 1, \ldots, H$. The estimate $\pi$ is provided by the object. The value $\pi_h(\theta)$ is a parametric bootstrap estimate where the bootstrap sample is generated from $\theta$ and a fixed seed (see ibControl). The greater the parameter value $H$ generally the better bias correction but the more computation it requires (see ibControl). If thetastart=NULL, the initial value of the procedure is $\theta(0) = \pi$. The number of iterations are controlled by maxit parameter of ibControl.

By default, the method correct coefficients only. For extra parameters, it depends on the model. For glm, if extra_param=TRUE: the shape parameter for the Gamma, the variance of the residuals in lm or the overdispersion parameter of the negative binomial regression in glm.nb, are also corrected. Note that the quasi families are not supported for the moment as they have no simulation method (see simulate). Bias correction for extra parameters of the inverse.gaussian is not yet implemented.

For lm, if extra_param=TRUE: the variance of the residuals is also corrected. Note that using the lb is not useful as coefficients are already unbiased, unless one considers different data generating mechanism such as censoring, missing values and outliers (see ibControl).

For lmer, by default, only the fixed effects are corrected. If extra_param=TRUE: all the random effects (variances and correlations) and the variance of the residuals are also corrected. Note that using the lb is certainly not useful with the argument REML=TRUE in lmer as the bias of variance components is already addressed, unless one considers different data generating mechanism such as censoring, missing values and outliers (see ibControl).

For nls, if extra_param=TRUE: the variance of the residuals is also corrected.

For vglm, extra_param is currently not used. Indeed, the philosophy of a vector generalized linear model is to potentially model all parameters of a distribution with a linear predictor. Hence, what would be considered an extra parameter in glm for instance, may already be captured by the default coefficients. However, correcting the bias of a coefficients does not imply that the bias of the parameter of the distribution is corrected (by Jensen’s inequality), so we may use this feature in a future version of the package. Note that we currently only support distributions with a simslot (see simulate.vlm).
Value

A fitted model object of class `ib`.

Author(s)

Samuel Orso

References


See Also

`glm`, `glm.nb`, `lm`, `lmer`, `nls`, `vglm`

Examples

```r
## poisson regression
counts <- c(18,17,15,20,10,20,25,13,12)
outcome <- gl(3,1,9)
treatment <- gl(3,3)
pois_fit <- glm(counts ~ outcome + treatment, family = poisson())
fit_ib <- ib(pois_fit)
summary(fit_ib)
## Set H = 1000
## Not run:
fit_ib <- ib(pois_fit, control=list(H=1000))
summary(fit_ib)
## End(Not run)

## gamma regression
clotting <- data.frame(
```
\[ u = (5,10,15,20,30,40,60,80,100), \]
\[ lot1 = (118,58,42,35,27,25,21,19,18), \]
\[ lot2 = (69,35,26,21,18,16,13,12,12)) \]

\[ \text{fit\_gamma} \leftarrow \text{glm}(\text{lot2} \sim \log(u), \text{data} = \text{clotting}, \text{family} = \text{Gamma(link = "inverse")}) \]
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_gamma)} \]

## summary(fit\_ib)

## correct for shape parameter and show iterations

## Not run:
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_gamma, control=list(\text{verbose}=\text{TRUE}), \text{extra\_param} = \text{TRUE})} \]
\[ \text{summary(fit\_ib)} \]

## End(Not run)

## negative binomial regression
\[ \text{library(MASS)} \]
\[ \text{fit\_nb} \leftarrow \text{glm.nb(Days} \sim \text{Sex/(Age + Eth*Lrn), data = quine)} \]
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_nb)} \]

## summary(fit\_ib)

## correct for overdispersion with H=100

## Not run:
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_nb, control=list(H=100), extra\_param} = \text{TRUE}) \]
\[ \text{summary(fit\_ib)} \]

## End(Not run)

## linear regression
\[ \text{fit\_lm} \leftarrow \text{lm(speed} \sim \text{dist, data = cars)} \]
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_lm)} \]

## summary(fit\_ib)

## correct for variance of residuals
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_lm, extra\_param} = \text{TRUE}) \]
\[ \text{summary(fit\_ib)} \]

## linear mixed-effects regression
\[ \text{library(lme4)} \]
\[ \text{fit\_lmm} \leftarrow \text{lmer(Reaction} \sim \text{Days + (Days} \mid \text{Subject), data = sleepstudy, REML = FALSE)} \]
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_lmm)} \]

## summary(fit\_ib)

## correct for variances and correlation

## Not run:
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_lmm, extra\_param} = \text{TRUE}) \]
\[ \text{summary(fit\_ib)} \]

## End(Not run)

## nonlinear regression
\[ \text{DNase1} \leftarrow \text{subset(DNase, Run == 1)} \]
\[ \text{fit\_nls} \leftarrow \text{nls(density} \sim \text{SSlogis(log(conc), Asym, xmid, scal), data = DNase1)} \]
\[ \text{fit\_ib} \leftarrow \text{ib(fit\_nls)} \]

## summary(fit\_ib)

## student regression
\[ \text{library(VGAM)} \]
```r
tdata <- data.frame(x = runif(nn <- 100))
tdata <- transform(tdata,
  y = rt(nn, df = exp(exp(0.5 - x))))
fit_vglm <- vglm(y ~ x, studentt3, data = tdata)
fit_ib <- ib(fit_vglm)
summary(fit_ib)
```

### ib, negbin-method

**ib method for negbin object from glm.nb function of MASS package.**

#### Description

**ib** method for negbin object from glm.nb function of MASS package.

#### Usage

```r
## S4 method for signature 'negbin'
ib(object, thetastart = NULL, control = list(...), extra_param = FALSE, ...)
```

#### Arguments

- **object**: an object representing a fitted model (see 'Details').
- **thetastart**: an optional starting value for the iterative procedure. If NULL (default), the procedure starts at the estimates in object.
- **control**: a list of parameters for controlling the iterative procedure (see **ibControl**).
- **extra_param**: if TRUE, the bias of estimation of extra parameters is performed (see 'Details').
- **...**: additional optional arguments (see 'Details').

#### ibControl

**Auxiliary for controlling IB**

#### Description

Auxiliary function for **ib** bias correction.

#### Usage

```r
ibControl(
  tol = 1e-05,
  maxit = 25,
  verbose = FALSE,
  seed = 123L,
  H = 1L,
  cens = FALSE,
  right = NULL,
```

```r
ibControl()
```
ibControl

left = NULL,
mis = FALSE,
prop = NULL,
out = FALSE,
eps = NULL,
G = NULL,
func = function(x) rowMeans(x, na.rm = T)
)

Arguments

tol positive convergence tolerance \( \epsilon \). The \texttt{ib} procedure converges when \( \| \hat{\theta}^{k+1} - \hat{\theta}^k \|_2/p < \epsilon \), where \( p \) is the dimension of \( \theta \).

maxit integer representing the maximal number of iterations.

verbose if TRUE, it prints some output in the console at each iteration.

seed integer to set the seed (see \texttt{Random}).

H integer representing the number of bootstrap estimates (see \texttt{ib}).

cens if TRUE the simulated responses are censored according to \texttt{left} and \texttt{right} values.

right double for right-censoring (only used if \texttt{cens}=TRUE).

left double for left-censoring (only used if \texttt{cens}=TRUE).

mis if TRUE the simulated responses have missing data at random.

prop double between 0 and 1 representing the proportion of missing data (only used if \texttt{mis}=TRUE).

out if TRUE the simulated responses are also generated with a contamination mechanism.

eps double between 0 and 1 representing the proportion of outliers in the data (only used if \texttt{out}=TRUE).

G a function to generate outliers. It takes only a sample size as argument.

func a function to reduce the \( H \) bootstrap estimates (rowwise). By default, the average is computed. The user can supply a function. One could imagine using other function such as the median or a trimmed mean.

Value

a list with components named as the arguments.

See Also

\texttt{ib}, the iterative procedure for bias correction.
IbGlm-class  
An S4 class union for ib

Description

Members of the union are IbGlm, IbLm, IbLmer, IbNegbin, IbNls, IbVglm

Details

The ‘Functions’ section describes members of the class union.

Functions

- IbGlm-class: fitted model by glm from stats
- IbLm-class: fitted model by lm from stats
- IbLmer-class: fitted model by lmer from lme4
- IbNegbin-class: fitted model by glm.nb from MASS
- IbNls-class: fitted model by nls from stats
- IbVglm-class: fitted model by vglm from VGAM

Author(s)

Samuel Orso

plot.Ib,ANY-method

Method for plotting an object in class union "Ib"

Description

Method for plotting an object in class union "Ib"

Usage

## S4 method for signature 'Ib,ANY'
plot(x, y = NULL, ...)

Arguments

x  
an object of class union "Ib"
y  
not used
...  
further arguments to pass to plot

See Also

Ib, plot.lm
**predict,Ib-method**  
Method for making predictions from an object in class union "Ib"

**Description**  
Method for making predictions from an object in class union "Ib"

**Usage**  
```r  
## S4 method for signature 'Ib'
predict(object, ...)  
```

**Arguments**  
- `object`: an object of class union "Ib"
- `...`: further arguments to pass to `predict`

**See Also**  
`Ib`, `predict`

**residuals,Ib-method**  
Method for extracting residuals from an object in class union "Ib"

**Description**  
Method for extracting residuals from an object in class union "Ib"

**Usage**  
```r  
## S4 method for signature 'Ib'
residuals(object, ...)  
```

**Arguments**  
- `object`: an object of class union "Ib"
- `...`: further arguments to pass to `residuals`

**See Also**  
`Ib`, `residuals`
**show, Ib-method**

*Method for printing object in class union "Ib"*

### Description

Method for printing object in class union "Ib"

### Usage

```r
## S4 method for signature 'Ib'
show(object)
```

### Arguments

- `object`: an object of class union "Ib"

### See Also

- `Ib`

---

**show, SummaryIb-method**

*Summarizing a fitted model corrected by the ib procedure*

### Description

Method for printing a summary of class union `SummaryIb`

### Usage

```r
## S4 method for signature 'SummaryIb'
show(object)
```

### Arguments

- `object`: a summary object of member of `SummaryIb`

### See Also

- `SummaryIb`
### summary, IbGlm-method

**Summary:**

A Generalized Linear Model regression fit corrected by the iterative bootstrap.

**Description**

A summary method for an object of class `IbGlm`.

**Usage**

```r
## S4 method for signature 'IbGlm'
summary(object, 
...)
```

**Arguments**

- `object`: an object of class `IbGlm`
- `...`: further arguments passed to `summary.glm`.

**See Also**

- `summary.glm`

### summary, IbLm-method

**Summary:**

A linear regression fit corrected by the iterative bootstrap.

**Description**

A summary method for an object of class `IbLm`.

**Usage**

```r
## S4 method for signature 'IbLm'
summary(object, 
...)
```

**Arguments**

- `object`: an object of class `IbLm`
- `...`: further arguments passed to `summary.lm`.

**See Also**

- `summary.lm`
summary.IbLmer-method

**Summary**

A linear mixed model regression fit corrected by the iterative bootstrap.

**Usage**

```r
## S4 method for signature 'IbLmer'
summary(object, ...)
```

**Arguments**

- `object`: an object of class `IbLmer`
- `...`: further arguments passed to `summary.merMod` of `lme4`

**Example**

```r
# Assuming 'model' is a fitted IbLmer model
summary(model)
```

---

summary.IbNegbin-method

**Summary**

A negative binomial regression fits corrected by the iterative bootstrap.

**Usage**

```r
## S4 method for signature 'IbNegbin'
summary(object, ...)
```

**Arguments**

- `object`: an object of class `IbNegbin`
- `...`: further arguments passed to `summary.negbin`

**Example**

```r
# Assuming 'model' is a fitted IbNegbin model
summary(model)
```

**See Also**

- `summary.negbin`
**summary.IbNls-method**  

*Summarizing a nonlinear regression fit corrected by the iterative bootstrap*

---

**Description**

summary method for class `IbNls`

**Usage**

```r
## S4 method for signature 'IbNls'
summary(object, ...)
```

**Arguments**

- `object` an object of class `IbNls`
- `...` further arguments passed to `summary.nls` of `stats`

---

**summary.IbVglm-method**  

*Summarizing a vector generalized linear model regression fit corrected by the iterative bootstrap*

---

**Description**

summary method for class `IbVglm`

**Usage**

```r
## S4 method for signature 'IbVglm'
summary(object, ...)
```

**Arguments**

- `object` an object of class `IbVglm`
- `...` further arguments passed to `summary.merMod` of `VGAM`
SummaryIbGlm-class  
An S4 class union for summary

Description

Members of the union are SummaryIbGlm, SummaryIbLm, SummaryIbLmer, SummaryIbNegbin, SummaryIbNls, SummaryIbVglm iterative bootstrap procedure

Details

The ‘Functions’ section describes members of the class union.

Functions

- SummaryIbGlm-class: summary of class summary.glm from stats
- SummaryIbLm-class: summary of class summary.lm from stats
- SummaryIbLmer-class: summary of class summary.merMod from lme4
- SummaryIbNegbin-class: summary of class summary.negbin from MASS
- SummaryIbNls-class: summary of class summary.nls from stats
- SummaryIbVglm-class: summary of class summary.vglm from VGAM

Author(s)

Samuel Orso

vcov, Ib-method  
Method for calculating covariance matrix from an object in class union "Ib"

Description

Method for calculating covariance matrix from an object in class union "Ib"

Usage

```r
## S4 method for signature 'Ib'
vcov(object, ...)
```

Arguments

- object  
an object of class union "Ib"
- ...  
further arguments to pass to vcov

See Also

- Ib, vcov
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