Package ‘betaNB’

April 14, 2024

Title Bootstrap for Regression Effect Sizes

Version 1.0.4

Description Generates nonparametric bootstrap confidence intervals
(Efron & Tibshirani, 1993: <doi:10.1201/9780429246593>)
for standardized regression coefficients (beta) and other effect sizes,
including multiple correlation, semipartial correlations,
improvement in R-squared, squared partial correlations,
and differences in standardized regression coefficients,
for models fitted by lm().

URL https://github.com/jeksterslab/betaNB,
https://jeksterslab.github.io/betaNB/

BugReports https://github.com/jeksterslab/betaNB/issues

License MIT + file LICENSE

Encoding UTF-8

LazyData true

Depends R (>= 3.5.0)

Imports stats

Suggests knitr, rmarkdown, testthat

RoxygenNote 7.3.1

NeedsCompilation no

Author Ivan Jacob Agaloos Pesigan [aut, cre, cph]
(<https://orcid.org/0000-0003-4818-8420>)

Maintainer Ivan Jacob Agaloos Pesigan <r.jeksterslab@gmail.com>

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R topics documented:

`BetaNB` *Estimate Standardized Regression Coefficients and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping*

Description

Estimate Standardized Regression Coefficients and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping

Usage

```
BetaNB(object, alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `nb`, that is, the output of the `NB()` function.
`alpha`	Numeric vector. Significance level α.

Details

The vector of standardized regression coefficients ($\hat{\boldsymbol{\beta}}$) is estimated from bootstrap samples. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of $\hat{\boldsymbol{\beta}}$, where α is the significance level.

Value

Returns an object of class betanb which is a list with the following elements:

call Function call.

args Function arguments.

thetahatstar Sampling distribution of $\hat{\beta}$.

jackknife Jackknife estimates.

est Vector of estimated $\hat{\beta}$.

fun Function used ("BetaNB").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Nonparametric Bootstrap Functions: DeltaRSqNB(), DiffBetaNB(), NB(), PCorNB(), RSqNB(), SCorNB()

Examples

```
# Data ---------------------------------------------------------------------
data("nas1982", package = "betaNB")

# Fit Model in lm ----------------------------------------------------------
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# NB -----------------------------------------------------------------------
nb <- NB(
  object,
  R = 100, # use a large value e.g., 5000L for actual research
  seed = 0508
)

# BetaNB -------------------------------------------------------------------
out <- BetaNB(nb, alpha = 0.05)

## Methods -----------------------------------------------------------------
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

coef.betanb — *Estimated Parameter Method for an Object of Class* `betanb`

Description

Estimated Parameter Method for an Object of Class `betanb`

Usage

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

Arguments

`object`	Object of Class `betanb`, that is, the output of the `BetaNB()`, `RSqNB()`, `SCorNB()`, `DeltaRSqNB()`, `PCorNB()`, or `DiffBetaNB()` functions.
`...`	additional arguments.

Value

Returns a vector of estimated parameters.

Author(s)

Ivan Jacob Agaloos Pesigan

confint.betanb — *Confidence Intervals Method for an Object of Class* `betanb`

Description

Confidence Intervals Method for an Object of Class `betanb`

Usage

```
## S3 method for class 'betanb'
confint(object, parm = NULL, level = 0.95, type = "pc", ...)
```

Arguments

`object`	Object of Class `betanb`, that is, the output of the `BetaNB()`, `RSqNB()`, `SCorNB()`, `DeltaRSqNB()`, `PCorNB()`, or `DiffBetaNB()` functions.
`parm`	a specification of which parameters are to be given confidence intervals, either a vector of numbers or a vector of names. If missing, all parameters are considered.
`level`	the confidence level required.
`type`	Charater string. Confidence interval type, that is, `type = "pc"` for percentile; `type = "bc"` for bias corrected; `type = "bca"` for bias corrected and accelerated.
`...`	additional arguments.

Value

Returns a matrix of confidence intervals.

Author(s)

Ivan Jacob Agaloos Pesigan

`DeltaRSqNB` *Estimate Improvement in R-Squared and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping*

Description

Estimate Improvement in R-Squared and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping

Usage

```
DeltaRSqNB(object, alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `nb`, that is, the output of the `NB()` function.
`alpha`	Numeric vector. Significance level α.

Details

The vector of improvement in R-squared (ΔR^2) is estimated from bootstrap samples. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of ΔR^2, where α is the significance level.

Value

Returns an object of class betanb which is a list with the following elements:

call Function call.

args Function arguments.

thetahatstar Sampling distribution of ΔR^2.

vcov Sampling variance-covariance matrix of ΔR^2.

est Vector of estimated ΔR^2.

fun Function used ("DeltaRSqNB").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Nonparametric Bootstrap Functions: BetaNB(), DiffBetaNB(), NB(), PCorNB(), RSqNB(), SCorNB()

Examples

```
# Data ---------------------------------------------------------------------
data("nas1982", package = "betaNB")

# Fit Model in lm ----------------------------------------------------------
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# NB -----------------------------------------------------------------------
nb <- NB(
  object,
  R = 100, # use a large value e.g., 5000L for actual research
  seed = 0508
)

# DeltaRSqNB ---------------------------------------------------------------
out <- DeltaRSqNB(nb, alpha = 0.05)

## Methods -----------------------------------------------------------------
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

DiffBetaNB *Estimate Differences of Standardized Slopes and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping*

Description

Estimate Differences of Standardized Slopes and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping

Usage

```
DiffBetaNB(object, alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `nb`, that is, the output of the `NB()` function.
`alpha`	Numeric vector. Significance level α.

Details

The vector of differences of standardized regression slopes is estimated from bootstrap samples. Confidence intervals are generated by obtaining percentiles corresponding to $100(1-\alpha)\%$ from the generated sampling distribution of differences of standardized regression slopes, where α is the significance level.

Value

Returns an object of class `betanb` which is a list with the following elements:

call Function call.

args Function arguments.

thetahatstar Sampling distribution of differences of standardized regression slopes.

vcov Sampling variance-covariance matrix of differences of standardized regression slopes.

est Vector of estimated differences of standardized regression slopes.

fun Function used ("DiffBetaNB").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Nonparametric Bootstrap Functions: `BetaNB()`, `DeltaRSqNB()`, `NB()`, `PCorNB()`, `RSqNB()`, `SCorNB()`

Examples

```
# Data -------------------------------------------------------------------
data("nas1982", package = "betaNB")

# Fit Model in lm ---------------------------------------------------------
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# NB ---------------------------------------------------------------------
nb <- NB(
  object,
  R = 100, # use a large value e.g., 5000L for actual research
  seed = 0508
)

# DiffBetaNB -------------------------------------------------------------
out <- DiffBetaNB(nb, alpha = 0.05)

## Methods ---------------------------------------------------------------
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

---

nas1982 *1982 National Academy of Sciences Doctoral Programs Data*

Description

1982 National Academy of Sciences Doctoral Programs Data

Usage

```
nas1982
```

Format

Ratings of 46 doctoral programs in psychology in the USA with the following variables:

QUALITY Program quality ratings.

NFACUL Number of faculty members in the program.

NGRADS Number of program graduates.

PCTSUPP Percentage of program graduates who received support.

PCTGRT Percent of faculty members holding research grants.

NARTIC Number of published articles attributed to program faculty member.

PCTPUB Percent of faculty with one or more published article.

References

National Research Council. (1982). *An assessment of research-doctorate programs in the United States: Social and behavioral sciences*. doi:10.17226/9781. Reproduced with permission from the National Academy of Sciences, Courtesy of the National Academies Press, Washington, D.C.

`NB` *Generate the Sampling Distribution of Sample Covariances Using Nonparametric Bootstrapping*

Description

Generate the Sampling Distribution of Sample Covariances Using Nonparametric Bootstrapping

Usage

```
NB(object, R = 5000L, seed = NULL)
```

Arguments

`object`	Object of class `lm`.
`R`	Positive integer. Number of bootstrap replications.
`seed`	Integer. Seed number for reproducibility.

Value

Returns an object of class `nb` which is a list with the following elements:

call Function call.

args Function arguments.

lm_process Processed `lm` object.

thetahatstar Sampling distribution of sample covariances.

jackknife Jackknife estimates.

Author(s)

Ivan Jacob Agaloos Pesigan

References

Efron, B., & Tibshirani, R. J. (1993) *An introduction to the bootstrap*. Chapman & Hall.

See Also

Other Beta Nonparametric Bootstrap Functions: `BetaNB()`, `DeltaRSqNB()`, `DiffBetaNB()`, `PCorNB()`, `RSqNB()`, `SCorNB()`

Examples

```
# Data ---------------------------------------------------------------------
data("nas1982", package = "betaNB")

# Fit Model in lm ----------------------------------------------------------
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# NB -----------------------------------------------------------------------
nb <- NB(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)
nb
# The `nb` object can be passed as the first argument
# to the following functions
#   - BetaNB
#   - DeltaRSqNB
#   - DiffBetaNB
#   - PCorNB
#   - RSqNB
#   - SCorNB
```

PCorNB — *Estimate Squared Partial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping*

Description

Estimate Squared Partial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping

Usage

```
PCorNB(object, alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `nb`, that is, the output of the `NB()` function.
`alpha`	Numeric vector. Significance level α.

Details

The vector of squared partial correlation coefficients (r^2_p) is estimated from bootstrap samples. Confidence intervals are generated by obtaining percentiles corresponding to $100(1-\alpha)\%$ from the generated sampling distribution of r^2_p, where α is the significance level.

Value

Returns an object of class betanb which is a list with the following elements:

call Function call.

args Function arguments.

thetahatstar Sampling distribution of r_p^2.

vcov Sampling variance-covariance matrix of r_p^2.

est Vector of estimated r_p^2.

fun Function used ("PCorNB").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Nonparametric Bootstrap Functions: BetaNB(), DeltaRSqNB(), DiffBetaNB(), NB(), RSqNB(), SCorNB()

Examples

```
# Data ---------------------------------------------------------------------
data("nas1982", package = "betaNB")

# Fit Model in lm ----------------------------------------------------------
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# NB -----------------------------------------------------------------------
nb <- NB(
  object,
  R = 100, # use a large value e.g., 5000L for actual research
  seed = 0508
)

# PCorNB -------------------------------------------------------------------
out <- PCorNB(nb, alpha = 0.05)

## Methods -----------------------------------------------------------------
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

print.betanb — *Print Method for an Object of Class* betanb

Description

Print Method for an Object of Class `betanb`

Usage

```
## S3 method for class 'betanb'
print(x, alpha = NULL, type = "pc", digits = 4, ...)
```

Arguments

`x`	Object of Class `betanb`, that is, the output of the `BetaNB()`, `RSqNB()`, `SCorNB()`, `DeltaRSqNB()`, `PCorNB()`, or `DiffBetaNB()` functions.
`alpha`	Numeric vector. Significance level α. If `alpha = NULL`, use the argument `alpha` used in `x`.
`type`	Charater string. Confidence interval type, that is, `type = "pc"` for percentile; `type = "bc"` for bias corrected; `type = "bca"` for bias corrected and accelerated.
`digits`	Digits to print.
`...`	additional arguments.

Value

Prints a matrix of estimates, standard errors, number of bootstrap replications, and confidence intervals.

Author(s)

Ivan Jacob Agaloos Pesigan

print.nb — *Print Method for an Object of Class* nb

Description

Print Method for an Object of Class `nb`

Usage

```
## S3 method for class 'nb'
print(x, ...)
```

Arguments

`x`	Object of Class `nb`.
`...`	additional arguments.

Value

Prints the first six bootstrap covariance matrices.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
nb <- NB(object, R = 100)
print(nb)
```

`RSqNB` *Estimate Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared) and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping*

Description

Estimate Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared) and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping

Usage

```
RSqNB(object, alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `nb`, that is, the output of the `NB()` function.
`alpha`	Numeric vector. Significance level α.

Details

R-squared (R^2) and adjusted R-squared ($\bar{R}^2$) is estimated from bootstrap samples. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of R^2 and $\bar{R}^2$, where α is the significance level.

Value

Returns an object of class `betanb` which is a list with the following elements:

call Function call.

args Function arguments.

thetahatstar Sampling distribution of R^2 and $\bar{R}^2$.

vcov Sampling variance-covariance matrix of R^2 and $\bar{R}^2$.

est Vector of estimated R^2 and $\bar{R}^2$.

fun Function used ("RSqNB").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Nonparametric Bootstrap Functions: `BetaNB()`, `DeltaRSqNB()`, `DiffBetaNB()`, `NB()`, `PCorNB()`, `SCorNB()`

Examples

```
# Data ---------------------------------------------------------------------
data("nas1982", package = "betaNB")

# Fit Model in lm ----------------------------------------------------------
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# NB -----------------------------------------------------------------------
nb <- NB(
  object,
  R = 100, # use a large value e.g., 5000L for actual research
  seed = 0508
)

# RSqNB --------------------------------------------------------------------
out <- RSqNB(nb, alpha = 0.05)

## Methods -----------------------------------------------------------------
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

SCorNB *Estimate Semipartial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping*

Description

Estimate Semipartial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping

Usage

```
SCorNB(object, alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `nb`, that is, the output of the `NB()` function.
`alpha`	Numeric vector. Significance level α.

Details

The vector of semipartial correlation coefficients (r_s) is estimated from bootstrap samples. Confidence intervals are generated by obtaining percentiles corresponding to $100(1-\alpha)\%$ from the generated sampling distribution of r_s, where α is the significance level.

Value

Returns an object of class `betanb` which is a list with the following elements:

call Function call.

args Function arguments.

thetahatstar Sampling distribution of r_s.

vcov Sampling variance-covariance matrix of r_s.

est Vector of estimated r_s.

fun Function used ("SCorNB").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Nonparametric Bootstrap Functions: `BetaNB()`, `DeltaRSqNB()`, `DiffBetaNB()`, `NB()`, `PCorNB()`, `RSqNB()`

Examples

```
# Data ---------------------------------------------------------------------
data("nas1982", package = "betaNB")

# Fit Model in lm ----------------------------------------------------------
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# NB -----------------------------------------------------------------------
nb <- NB(
  object,
  R = 100, # use a large value e.g., 5000L for actual research
  seed = 0508
)

# SCorNB -------------------------------------------------------------------
out <- SCorNB(nb, alpha = 0.05)

## Methods -----------------------------------------------------------------
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

---

summary.betanb — *Summary Method for an Object of Class* betanb

---

Description

Summary Method for an Object of Class `betanb`

Usage

```
## S3 method for class 'betanb'
summary(object, alpha = NULL, type = "pc", digits = 4, ...)
```

Arguments

`object`	Object of Class `betanb`, that is, the output of the `BetaNB()`, `RSqNB()`, `SCorNB()`, `DeltaRSqNB()`, `PCorNB()`, or `DiffBetaNB()` functions.
`alpha`	Numeric vector. Significance level α. If `alpha = NULL`, use the argument `alpha` used in `object`.
`type`	Charater string. Confidence interval type, that is, `type = "pc"` for percentile; `type = "bc"` for bias corrected; `type = "bca"` for bias corrected and accelerated.
`digits`	Digits to print.
`...`	additional arguments.

Value

Returns a matrix of estimates, standard errors, number of bootstrap replications, and confidence intervals.

Author(s)

Ivan Jacob Agaloos Pesigan

`vcov.betanb` *Sampling Variance-Covariance Matrix Method for an Object of Class* `betanb`

Description

Sampling Variance-Covariance Matrix Method for an Object of Class `betanb`

Usage

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

Arguments

`object`	Object of Class `betanb`, that is, the output of the `BetaNB()`, `RSqNB()`, `SCorNB()`, `DeltaRSqNB()`, `PCorNB()`, or `DiffBetaNB()` functions.
`...`	additional arguments.

Value

Returns the variance-covariance matrix of estimates.

Author(s)

Ivan Jacob Agaloos Pesigan

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