

Package ‘betaNB’

July 8, 2023

Title Bootstrap for Regression Effect Sizes

Version 1.0.2

Description Generates nonparametric bootstrap confidence intervals (Efron & Tibshirani, 1993: <[doi:10.1201/9780429246593](https://doi.org/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

Roxygen list(markdown = TRUE)

Depends R (>= 3.5.0)

Imports stats

Suggests knitr, rmarkdown, testthat

RoxygenNote 7.2.3

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>

R topics documented:

BetaNB	2
coef.betanb	3
confint.betanb	4

DeltaRSqNB	5
DiffBetaNB	6
nas1982	8
NB	8
PCorNB	10
print.betanb	11
print.nb	12
RSqNB	13
SCorNB	14
summary.betanb	16
vcov.betanb	16

Index 18

BetaNB	<i>Estimate Standardized Regression Coefficients and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping</i>
--------	---

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 ($\hat{\beta}$) is estimated from bootstrap samples. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of $\hat{\beta}$, 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	<i>Confidence Intervals Method for an Object of Class betanb</i>
----------------	--

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 Character 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

<code>object</code>	Object of class <code>lm</code> .
<code>R</code>	Positive integer. Number of bootstrap replications.
<code>seed</code>	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_p^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_p^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_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	<i>Estimate Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared) and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping</i>
-------	---

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	<i>Summary Method for an Object of Class betanb</i>
----------------	---

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	Character 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	<i>Sampling Variance-Covariance Matrix Method for an Object of Class betanb</i>
-------------	---

Description

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

Usage

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


Arguments

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

Value

Returns the variance-covariance matrix of estimates.

Author(s)

Ivan Jacob Agaloos Pesigan

Index

* **Beta Nonparametric Bootstrap Functions**

BetaNB, [2](#)
DeltaRSqNB, [5](#)
DiffBetaNB, [6](#)
NB, [8](#)
PCorNB, [10](#)
RSqNB, [13](#)
SCorNB, [14](#)

* **betaNB**

BetaNB, [2](#)
DeltaRSqNB, [5](#)
DiffBetaNB, [6](#)
NB, [8](#)
PCorNB, [10](#)
RSqNB, [13](#)
SCorNB, [14](#)

* **data**

nas1982, [8](#)

* **deltarsq**

DeltaRSqNB, [5](#)

* **diff**

DiffBetaNB, [6](#)

* **methods**

coef.betanb, [3](#)
confint.betanb, [4](#)
print.betanb, [11](#)
print.nb, [12](#)
summary.betanb, [16](#)
vcov.betanb, [16](#)

* **nb**

NB, [8](#)

* **pcor**

PCorNB, [10](#)

* **rsq**

RSqNB, [13](#)

* **scor**

SCorNB, [14](#)

* **std**

BetaNB, [2](#)

BetaNB, [2](#), [5](#), [7](#), [9](#), [10](#), [13](#), [15](#)

coef.betanb, [3](#)
confint.betanb, [4](#)

DeltaRSqNB, [3](#), [5](#), [7](#), [9](#), [10](#), [13](#), [15](#)
DiffBetaNB, [3](#), [5](#), [6](#), [9](#), [10](#), [13](#), [15](#)

nas1982, [8](#)
NB, [3](#), [5](#), [7](#), [8](#), [10](#), [13](#), [15](#)

PCorNB, [3](#), [5](#), [7](#), [9](#), [10](#), [13](#), [15](#)
print.betanb, [11](#)
print.nb, [12](#)

RSqNB, [3](#), [5](#), [7](#), [9](#), [10](#), [13](#), [15](#)

SCorNB, [3](#), [5](#), [7](#), [9](#), [10](#), [13](#), [14](#)
summary.betanb, [16](#)

vcov.betanb, [16](#)