

# Package ‘betaNB’

April 12, 2023

**Title** Bootstrap for Regression Effect Sizes

**Version** 1.0.1

**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, methods

**Suggests** knitr, rmarkdown, testthat

**RoxygenNote** 7.2.3

**NeedsCompilation** no

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

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

## Usage

BetaNB(object)

## Arguments

**object** Object of class mc, that is, the output of the MC() function.

## 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  $\alpha$  is the significance level.

## Value

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

**call** Function call.

**object** The function argument object.

**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: [.CI\(\)](#), [DeltaRSqNB\(\)](#), [DiffBetaNB\(\)](#), [NB\(\)](#), [PCorNB\(\)](#), [RSqNB\(\)](#), [SCorNB\(\)](#)

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate the sampling distribution of sample covariances
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
std <- BetaNB(nb)
# Methods -----
print(std)
summary(std)
coef(std)
vcov(std)
confint(std, 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

## Examples

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate bootstrap covariance matrices
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
std <- BetaNB(nb)
# Method -----
coef(std)
```

---

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	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

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate bootstrap covariance matrices
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
std <- BetaNB(nb)
# Method -----
confint(std, level = 0.95, type = "pc")
confint(std, level = 0.95, type = "bc")
confint(std, level = 0.95, type = "bca")
```

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DeltaRSqNB	<i>Estimate Improvement in R-Squared and Generate the Corresponding Sampling Distribution Using Nonparametric Bootstrapping</i>
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**Description**

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

**Usage**

```
DeltaRSqNB(object)
```

**Arguments**

**object** Object of class mc, that is, the output of the MC() function.

**Details**

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

**Value**

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

**call** Function call.

**object** The function argument object.

**thetahatstar** Sampling distribution of  $\Delta R^2$ .

**vcov** Sampling variance-covariance matrix of  $\Delta R^2$ .

**est** Vector of estimated  $\Delta R^2$ .

**fun** Function used ("DeltaRSqMC").

**Author(s)**

Ivan Jacob Agaloos Pesigan

**See Also**

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

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate the sampling distribution of sample covariances
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for improvement in R-squared
deltarsq <- DeltaRSqNB(nb)
# Methods -----
print(deltarsq)
summary(deltarsq)
coef(deltarsq)
vcov(deltarsq)
confint(deltarsq, 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)
```

**Arguments**

`object`                      Object of class `mc`, that is, the output of the `MC()` function.

**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  $\alpha$  is the significance level.

**Value**

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

**call** Function call.

**object** The function argument object.

**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 ("DiffBetaMC").

**Author(s)**

Ivan Jacob Agaloos Pesigan

**See Also**

Other Beta Nonparametric Bootstrap Functions: [.CI\(\)](#), [BetaNB\(\)](#), [DeltaRSqNB\(\)](#), [NB\(\)](#), [PCorNB\(\)](#), [RSqNB\(\)](#), [SCorNB\(\)](#)

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate the sampling distribution of sample covariances
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals
# for differences of standardized regression slopes
diff <- DiffBetaNB(nb)
# Methods -----
print(diff)
summary(diff)
coef(diff)
vcov(diff)
confint(diff, 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.

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NB	<i>Generate the Sampling Distribution of Sample Covariances Using Nonparametric Bootstrapping</i>
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### Description

Generate the Sampling Distribution of Sample Covariances Using Nonparametric Bootstrapping

### Usage

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

### Arguments

<b>object</b>	Object of class <code>lm</code> .
<b>R</b>	Positive integer. Number of bootstrap replications.
<b>seed</b>	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: [.CI\(\)](#), [BetaNB\(\)](#), [DeltaRSqNB\(\)](#), [DiffBetaNB\(\)](#), [PCorNB\(\)](#), [RSqNB\(\)](#), [SCorNB\(\)](#)

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate the sampling distribution of sample covariances
# (use a large R, for example, R = 5000 for actual research)
NB(object, R = 100)
```

---

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)
```

**Arguments**

**object**                      Object of class mc, that is, the output of the MC() function.

**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  $\alpha$  is the significance level.

**Value**

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

**call** Function call.

**object** The function argument object.

**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 ("PCorMC").

**Author(s)**

Ivan Jacob Agaloos Pesigan

**See Also**

Other Beta Nonparametric Bootstrap Functions: [.CI\(\)](#), [BetaNB\(\)](#), [DeltaRSqNB\(\)](#), [DiffBetaNB\(\)](#), [NB\(\)](#), [RSqNB\(\)](#), [SCorNB\(\)](#)

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate the sampling distribution of sample covariances
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
rp <- PCorNB(nb)
# Methods -----
print(rp)
summary(rp)
coef(rp)
vcov(rp)
confint(rp, 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 = c(0.05, 0.01, 0.001), 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	Significance level.
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

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate bootstrap covariance matrices
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
std <- BetaNB(nb)
# Method -----
print(std, type = "pc")
print(std, type = "bc")
print(std, type = "bca")
```

---

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**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate bootstrap covariance matrices
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
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)

**Arguments**

**object** Object of class mc, that is, the output of the MC() function.

**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  $\alpha$  is the significance level.

**Value**

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

**call** Function call.

**object** The function argument object.

**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 ("RSqMC").

### Author(s)

Ivan Jacob Agaloos Pesigan

### See Also

Other Beta Nonparametric Bootstrap Functions: [.CI\(\)](#), [BetaNB\(\)](#), [DeltaRSqNB\(\)](#), [DiffBetaNB\(\)](#), [NB\(\)](#), [PCorNB\(\)](#), [SCorNB\(\)](#)

### Examples

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate the sampling distribution of sample covariances
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
rsq <- RSqNB(nb)
# Methods -----
print(rsq)
summary(rsq)
coef(rsq)
vcov(rsq)
confint(rsq, 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)
```

### Arguments

**object** Object of class `mc`, that is, the output of the `MC()` function.

## 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  $\alpha$  is the significance level.

## Value

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

**call** Function call.

**object** The function argument object.

**thetahatstar** Sampling distribution of  $r_s$ .

**vcov** Sampling variance-covariance matrix of  $r_s$ .

**est** Vector of estimated  $r_s$ .

**fun** Function used ("SCorMC").

## Author(s)

Ivan Jacob Agaloos Pesigan

## See Also

Other Beta Nonparametric Bootstrap Functions: [.CI\(\)](#), [BetaNB\(\)](#), [DeltaRSqNB\(\)](#), [DiffBetaNB\(\)](#), [NB\(\)](#), [PCorNB\(\)](#), [RSqNB\(\)](#)

## Examples

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate the sampling distribution of sample covariances
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
rs <- SCorNB(nb)
# Methods -----
print(rs)
summary(rs)
coef(rs)
vcov(rs)
confint(rs, 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 = c(0.05, 0.01, 0.001), 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	Significance level.
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

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate bootstrap covariance matrices
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
std <- BetaNB(nb)
# Method -----
summary(std, type = "pc")
summary(std, type = "bc")
summary(std, type = "bca")
```

---

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**

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

**Examples**

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
# Generate bootstrap covariance matrices
# (use a large R, for example, R = 5000 for actual research)
nb <- NB(object, R = 50)
# Generate confidence intervals for standardized regression slopes
std <- BetaNB(nb)
# Method -----
vcov(std)
```



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