# Package 'betaSandwich'

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<b>Title</b> Robust Confidence Intervals for Standardized Regression Coefficients
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<b>Description</b> Generates robust confidence intervals for standardized regression coefficients using heteroskedasticity-consistent standard errors for models fitted by lm() as described in Dudgeon (2017) <doi:10.1007 s11336-017-9563-z="">.</doi:10.1007>
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## **Description**

Estimate Standardized Regression Coefficients and the Corresponding Sampling Covariance Matrix Using the Asymptotic Distribution-Free Approach

# Usage

BetaADF(object)

# Arguments

object Object of class 1m.

#### **Details**

Note that while the calculation in BetaADF() is different from betaDelta::BetaDelta() with type = "adf", the results are numerically equivalent. BetaADF() is appropriate when sample sizes are moderate to large (n > 250). BetaHC() is recommended in most situations.

# Value

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

call Function call.

args Function arguments.

BetaHC 3

lm\_process Processed 1m object.

**gamma\_n** Asymptotic covariance matrix of the sample covariance matrix assuming multivariate normality.

gamma\_hc Asymptotic covariance matrix HC correction.

gamma Asymptotic covariance matrix of the sample covariance matrix.

acov Asymptotic covariance matrix of the standardized slopes.

vcov Sampling covariance matrix of the standardized slopes.

est Vector of standardized slopes.

#### Author(s)

Ivan Jacob Agaloos Pesigan

#### References

Browne, M. W. (1984). Asymptotically distribution-free methods for the analysis of covariance structures. *British Journal of Mathematical and Statistical Psychology*, *37*(1), 62–83. doi:10.1111/j.20448317.1984.tb00789.x

Dudgeon, P. (2017). Some improvements in confidence intervals for standardized regression coefficients. *Psychometrika*, 82(4), 928–951. doi:10.1007/s113360179563z

#### See Also

 $Other\ Beta\ Sandwich\ Functions:\ BetaHC(), BetaN(), DiffBetaSandwich(), RSqBetaSandwich()$ 

# Examples

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaADF(object)
# Methods ------
print(std)
summary(std)
coef(std)
vcov(std)
confint(std, level = 0.95)</pre>
```

BetaHC

Estimate Standardized Regression Coefficients and the Corresponding Robust Sampling Covariance Matrix Using the Heteroskedasticity Consistent Approach

#### **Description**

Estimate Standardized Regression Coefficients and the Corresponding Robust Sampling Covariance Matrix Using the Heteroskedasticity Consistent Approach 4 BetaHC

#### Usage

```
BetaHC(object, type = "hc3", g1 = 1, g2 = 1.5, k = 0.7)
```

## **Arguments**

object	Object of class 1m.
type	Character string. Correction type. Possible values are "hc0", "hc1", "hc2", "hc3", "hc4", "hc4m", and "hc5".
g1	Numeric. g1 value for type = "hc4m" or type = "hc5".
g2	Numeric. g2 value for type = "hc4m".
k	Numeric. Constant for type = "hc5"

#### Value

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

call Function call.

args Function arguments.

lm\_process Processed 1m object.

**gamma\_n** Asymptotic covariance matrix of the sample covariance matrix assuming multivariate normality.

gamma\_hc Asymptotic covariance matrix HC correction.

**gamma** Asymptotic covariance matrix of the sample covariance matrix.

acov Asymptotic covariance matrix of the standardized slopes.

vcov Sampling covariance matrix of the standardized slopes.

est Vector of standardized slopes.

#### Author(s)

Ivan Jacob Agaloos Pesigan

## References

Dudgeon, P. (2017). Some improvements in confidence intervals for standardized regression coefficients. *Psychometrika*, 82(4), 928–951. doi:10.1007/s113360179563z

#### See Also

Other Beta Sandwich Functions: BetaADF(), BetaN(), DiffBetaSandwich(), RSqBetaSandwich()

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## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
# Methods ------
print(std)
summary(std)
coef(std)
vcov(std)
confint(std, level = 0.95)</pre>
```

BetaN

Estimate Standardized Regression Coefficients and the Corresponding Sampling Covariance Matrix Assuming Multivariate Normality

## **Description**

Estimate Standardized Regression Coefficients and the Corresponding Sampling Covariance Matrix Assuming Multivariate Normality

#### Usage

```
BetaN(object)
```

#### **Arguments**

object

Object of class 1m.

#### Details

Note that while the calculation in BetaN() is different from betaDelta::BetaDelta() with type = "mvn", the results are numerically equivalent. BetaN() assumes multivariate normality. BetaHC() is recommended in most situations.

## Value

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

call Function call.

args Function arguments.

lm\_process Processed 1m object.

**gamma\_n** Asymptotic covariance matrix of the sample covariance matrix assuming multivariate normality.

gamma hc Asymptotic covariance matrix HC correction.

gamma Asymptotic covariance matrix of the sample covariance matrix.

acov Asymptotic covariance matrix of the standardized slopes.

vcov Sampling covariance matrix of the standardized slopes.

est Vector of standardized slopes.

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#### Author(s)

Ivan Jacob Agaloos Pesigan

#### References

Dudgeon, P. (2017). Some improvements in confidence intervals for standardized regression coefficients. *Psychometrika*, 82(4), 928–951. doi:10.1007/s113360179563z

## See Also

Other Beta Sandwich Functions: BetaADF(), BetaHC(), DiffBetaSandwich(), RSqBetaSandwich()

## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaN(object)
# Methods -------
print(std)
summary(std)
coef(std)
vcov(std)
confint(std, level = 0.95)</pre>
```

coef.betasandwich

Standardized Regression Slopes

# Description

Standardized Regression Slopes

## Usage

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

# Arguments

```
object Object of class betasandwich.
... additional arguments.
```

## Value

Returns a vector of standardized regression slopes.

## Author(s)

Ivan Jacob Agaloos Pesigan

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## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
coef(std)</pre>
```

coef.diffbetasandwich Differences of Standardized Regression Slopes

# Description

Differences of Standardized Regression Slopes

## Usage

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

## **Arguments**

object Object of class diffbetasandwich.
... additional arguments.

#### Value

Returns a vector of differences of standardized regression slopes.

# Author(s)

Ivan Jacob Agaloos Pesigan

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
diff <- DiffBetaSandwich(std)
coef(diff)</pre>
```

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## **Description**

Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared)

## Usage

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

## Arguments

object Object of class rsqbetasandwich.
... additional arguments.

#### Value

Returns a vector of multiple correlation coefficients (R-squared and adjusted R-squared)

## Author(s)

Ivan Jacob Agaloos Pesigan

#### **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
rsq <- RSqBetaSandwich(std)
coef(rsq)</pre>
```

confint.betasandwich Confidence Intervals for Standardized Regression Slopes

# Description

Confidence Intervals for Standardized Regression Slopes

## Usage

```
## S3 method for class 'betasandwich'
confint(object, parm = NULL, level = 0.95, ...)
```

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#### **Arguments**

object Object of class betasandwich.

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 consid-

ered.

level the confidence level required.

... additional arguments.

#### Value

Returns a matrix of confidence intervals.

#### Author(s)

Ivan Jacob Agaloos Pesigan

## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
confint(std, level = 0.95)</pre>
```

confint.diffbetasandwich

Confidence Intervals for Differences of Standardized Regression Slopes

## **Description**

Confidence Intervals for Differences of Standardized Regression Slopes

#### Usage

```
## S3 method for class 'diffbetasandwich'
confint(object, parm = NULL, level = 0.95, ...)
```

#### **Arguments**

object Object of class diffbetasandwich.

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 consid-

ered.

level the confidence level required.

... additional arguments.

#### Value

Returns a matrix of confidence intervals.

## Author(s)

Ivan Jacob Agaloos Pesigan

## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
diff <- DiffBetaSandwich(std)
confint(diff, level = 0.95)</pre>
```

confint.rsqbetasandwich

Confidence Intervals for Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared)

#### **Description**

Confidence Intervals for Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared)

## Usage

```
## S3 method for class 'rsqbetasandwich'
confint(object, parm = NULL, level = 0.95, ...)
```

## **Arguments**

object Object of class rsqbetasandwich.

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 consid-

ered.

level the confidence level required.

... additional arguments.

## Value

Returns a matrix of confidence intervals.

#### Author(s)

Ivan Jacob Agaloos Pesigan

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#### **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
rsq <- RSqBetaSandwich(std)
confint(rsq, level = 0.95)</pre>
```

DiffBetaSandwich

Estimate Differences of Standardized Slopes and the Corresponding Sampling Covariance Matrix

#### **Description**

Estimate Differences of Standardized Slopes and the Corresponding Sampling Covariance Matrix

## Usage

```
DiffBetaSandwich(object)
```

## **Arguments**

object

Object of class betasandwich, that is, the output of the BetaHC(), BetaN(), or BetaADF() functions.

#### Value

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

fit The argument object.

vcov Sampling covariance matrix of differences of standardized slopes.

est Vector of differences of standardized slopes.

#### Author(s)

Ivan Jacob Agaloos Pesigan

#### See Also

```
Other Beta Sandwich Functions: BetaADF(), BetaHC(), BetaN(), RSqBetaSandwich()
```

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
diff <- DiffBetaSandwich(std)
# Methods ------
print(diff)
summary(diff)
coef(diff)
vcov(diff)
confint(diff, level = 0.95)</pre>
```

print.betasandwich

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.

print.betasandwich

Print Method for an Object of Class betasandwich

## **Description**

Print Method for an Object of Class betasandwich

## Usage

```
## S3 method for class 'betasandwich' print(x, alpha = c(0.05, 0.01, 0.001), digits = 4, ...)
```

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## **Arguments**

X	Object of class betasandwich.
alpha	Significance level.
digits	Digits to print.
	additional arguments.

#### Value

Returns a matrix of standardized regression slopes, standard errors, test statistics, p-values, and confidence intervals.

## Author(s)

Ivan Jacob Agaloos Pesigan

## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
print(std)</pre>
```

```
print.diffbetasandwich
```

Print Method for an Object of Class diffbetasandwich

# Description

Print Method for an Object of Class diffbetasandwich

# Usage

```
## S3 method for class 'diffbetasandwich' print(x, alpha = c(0.05, 0.01, 0.001), digits = 4, ...)
```

## **Arguments**

X	Object of class diffbetasandwich.
alpha	Significance level.
digits	Digits to print.
	additional arguments.

#### Value

Returns a matrix of differences of standardized regression slopes, standard errors, test statistics, p-values, and confidence intervals.

print.rsqbetasandwich

#### Author(s)

Ivan Jacob Agaloos Pesigan

## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
diff <- DiffBetaSandwich(std)
print(diff)</pre>
```

print.rsqbetasandwich Print Method for an Object of Class rsqbetasandwich

## **Description**

Print Method for an Object of Class rsqbetasandwich

## Usage

```
## S3 method for class 'rsqbetasandwich' print(x, alpha = c(0.05, 0.01, 0.001), digits = 4, ...)
```

## **Arguments**

```
x Object of class rsqbetasandwich.alpha Significance level.digits Digits to print.... additional arguments.
```

## Value

Returns a matrix of multiple correlation coefficients (R-squared and adjusted R-squared), standard errors, test statistics, p-values, and confidence intervals.

## Author(s)

Ivan Jacob Agaloos Pesigan

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
rsq <- RSqBetaSandwich(std)
print(rsq)</pre>
```

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RSqBetaSandwich	Estimate Multiple Correlation Coefficients (R-squared and adjusted
	R-squared) and the Corresponding Sampling Covariance Matrix

# **Description**

Estimate Multiple Correlation Coefficients (R-squared and adjusted R-squared) and the Corresponding Sampling Covariance Matrix

# Usage

```
RSqBetaSandwich(object)
```

## **Arguments**

object

Object of class betasandwich, that is, the output of the BetaHC(), BetaN(), or BetaADF() functions.

#### Value

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

```
fit The argument object.
```

**vcov** Sampling covariance matrix of multiple correlation coefficients (R-squared and adjusted R-squared).

est Vector of multiple correlation coefficients (R-squared and adjusted R-squared).

## Author(s)

Ivan Jacob Agaloos Pesigan

#### See Also

```
Other Beta Sandwich Functions: BetaADF(), BetaHC(), BetaN(), DiffBetaSandwich()
```

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
rsq <- RSqBetaSandwich(std)
# Methods ------
print(rsq)
summary(rsq)
coef(rsq)
vcov(rsq)
confint(rsq, level = 0.95)</pre>
```

summary.betasandwich Summary Method for an Object of Class betasandwich

## **Description**

Summary Method for an Object of Class betasandwich

## Usage

```
## S3 method for class 'betasandwich' summary(object, alpha = c(0.05, 0.01, 0.001), digits = 4, ...)
```

## Arguments

object Object of class betasandwich.

alpha Significance level.

digits Digits to print.

... additional arguments.

#### Value

Returns a matrix of standardized regression slopes, standard errors, test statistics, p-values, and confidence intervals.

## Author(s)

Ivan Jacob Agaloos Pesigan

#### **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
summary(std)</pre>
```

summary.diffbetasandwich

Summary Method for an Object of Class diffbetasandwich

## Description

Summary Method for an Object of Class diffbetasandwich

#### Usage

```
## S3 method for class 'diffbetasandwich' summary(object, alpha = c(0.05, 0.01, 0.001), digits = 4, ...)
```

## Arguments

object	Object of class diffbetasandwich.
alpha	Significance level.
digits	Digits to print.
	additional arguments.

#### Value

Returns a matrix of differences of standardized regression slopes, standard errors, test statistics, p-values, and confidence intervals.

#### Author(s)

Ivan Jacob Agaloos Pesigan

## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
diff <- DiffBetaSandwich(std)
summary(diff)</pre>
```

summary.rsqbetasandwich

Summary Method for an Object of Class rsqbetasandwich

## **Description**

Summary Method for an Object of Class rsqbetasandwich

# Usage

```
## S3 method for class 'rsqbetasandwich' summary(object, alpha = c(0.05, 0.01, 0.001), digits = 4, ...)
```

#### Arguments

```
object Object of class rsqbetasandwich.

alpha Significance level.

digits Digits to print.

... additional arguments.
```

#### Value

Returns a matrix of multiple correlation coefficients (R-squared and adjusted R-squared), standard errors, test statistics, p-values, and confidence intervals.

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#### Author(s)

Ivan Jacob Agaloos Pesigan

# **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
rsq <- RSqBetaSandwich(std)
summary(rsq)</pre>
```

vcov.betasandwich

Sampling Covariance Matrix of the Standardized Regression Slopes

# Description

Sampling Covariance Matrix of the Standardized Regression Slopes

## Usage

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

## **Arguments**

object Object of class betasandwich.additional arguments.

#### Value

Returns a matrix of the variance-covariance matrix of standardized slopes.

#### Author(s)

Ivan Jacob Agaloos Pesigan

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
vcov(std)</pre>
```

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vcov.diffbetasandwich Sampling Covariance Matrix of Differences of Standardized Regression Slopes

## **Description**

Sampling Covariance Matrix of Differences of Standardized Regression Slopes

## Usage

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

## **Arguments**

object Object of class diffbetasandwich.
... additional arguments.

## Value

Returns a matrix of the variance-covariance matrix of differences of standardized regression slopes.

#### Author(s)

Ivan Jacob Agaloos Pesigan

## **Examples**

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
diff <- DiffBetaSandwich(std)
vcov(diff)</pre>
```

vcov.rsqbetasandwich Sampling Covariance Matrix of Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared)

# Description

Sampling Covariance Matrix of Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared)

## Usage

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

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# Arguments

object Object of class rsqbetasandwich. ... additional arguments.

#### Value

Returns a matrix of the variance-covariance matrix of multiple correlation coefficients (R-squared and adjusted R-squared).

# Author(s)

Ivan Jacob Agaloos Pesigan

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaHC(object)
rsq <- RSqBetaSandwich(std)
vcov(rsq)</pre>
```

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