

# Package ‘betaSandwich’

February 10, 2023

**Title** Robust Confidence Intervals for Standardized Regression Coefficients

**Version** 1.0.3.9000

**Description** 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](https://doi.org/10.1007/s11336-017-9563-z)>.

**URL** <https://github.com/jeksterslab/betaSandwich>,  
<https://jeksterslab.github.io/betaSandwich/>

**BugReports** <https://github.com/jeksterslab/betaSandwich/issues>

**License** MIT + file LICENSE

**Encoding** UTF-8

**LazyData** true

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**Depends** R (>= 3.5.0)

**Imports** methods

**Suggests** knitr, rmarkdown, testthat

**RoxygenNote** 7.2.3

**NeedsCompilation** no

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BetaADF	<i>Estimate Standardized Regression Coefficients and Sampling Covariance Matrix Using the Asymptotic Distribution-Free Approach</i>
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**Description**

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

**Usage**

BetaADF(object)

**Arguments**

object                      Object of class lm.

**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.
- lm** Object of class lm.
- lm\_process** Pre-processed object of class lm.

**type** Standard error type.  
**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

### See Also

Other Beta Sandwich Functions: [BetaHC\(\)](#), [BetaN\(\)](#)

### 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)
## Differences of standardized regression coefficients -----
out <- dif(std)
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
## Multiple Correlation -----
out <- rsq(std)
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

---

BetaHC

*Estimate Standardized Regression Coefficients and Robust Sampling  
Covariance Matrix*

---

### Description

Estimate Standardized Regression Coefficients and Robust Sampling Covariance Matrix

**Usage**

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

**Arguments**

<b>object</b>	Object of class <code>lm</code> .
<b>type</b>	Character string. Correction type. Possible values are "hc0", "hc1", "hc2", "hc3", "hc4", "hc4m", and "hc5".
<b>g1</b>	Numeric. g1 value for type = "hc4m" or type = "hc5".
<b>g2</b>	Numeric. g2 value for type = "hc4m".
<b>k</b>	Numeric. Constant for type = "hc5"

**Value**

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

**call** Function call.

**lm** Object of class `lm`.

**lm\_process** Pre-processed object of class `lm`.

**type** Standard error type.

**gamman** Asymptotic covariance matrix of the sample covariance matrix assuming multivariate normal distribution.

**gammahc** Asymptotic covariance matrix HC adjustment.

**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](https://doi.org/10.1007/s113360179563z)

**See Also**

Other Beta Sandwich Functions: [BetaADF\(\)](#), [BetaN\(\)](#)

**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)
## Differences of standardized regression coefficients -----
out <- dif(std)
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
## Multiple Correlation -----
out <- rsq(std)
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)

```

BetaN

*Estimate Standardized Regression Coefficients and Sampling Covariance Matrix Assuming Multivariate Normality*

**Description**

Estimate Standardized Regression Coefficients and Sampling Covariance Matrix Assuming Multivariate Normality

**Usage**

```
BetaN(object)
```

**Arguments**

object            Object of class `lm`.

**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.

**lm** Object of class `lm`.

**lm\_process** Pre-processed object of class `lm`.

**type** Standard error type.

**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

**See Also**

Other Beta Sandwich Functions: [BetaADF\(\)](#), [BetaHC\(\)](#)

**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)
## Differences of standardized regression coefficients -----
out <- dif(std)
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
## Multiple Correlation -----
out <- rsq(std)
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

---

coef.betasandwich	<i>Standardized Regression Slopes</i>
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**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

**Examples**

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

---

coef.difbetasandwich	<i>Differences of Standardized Regression Slopes</i>
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---

**Description**

Differences of Standardized Regression Slopes

**Usage**

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

**Arguments**

object	Object of class difbetasandwich.
...	additional arguments.

**Value**

Returns a vector of differences of standardized regression slopes.

**Author(s)**

Ivan Jacob Agaloos Pesigan

**Examples**

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

---

coef.rsqbetasandwich    *Differences of Standardized Regression Slopes*

---

**Description**

Differences of Standardized Regression Slopes

**Usage**

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

**Arguments**

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

**Value**

Returns a vector of differences of standardized regression slopes.

**Author(s)**

Ivan Jacob Agaloos Pesigan

**Examples**

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



---

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, ...)
```

## 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 considered.
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)
```

---

confint.difbetasandwich    *Confidence Intervals for Differences of Standardized Regression Slopes*

---

## Description

Confidence Intervals for Differences of Standardized Regression Slopes

**Usage**

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

**Arguments**

object	Object of class difbetasandwich.
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.
...	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)
out <- dif(std)
confint(out, level = 0.95)
```

---

confint.rsqbetasandwich

*Confidence Intervals for Differences of Standardized Regression Slopes*

---

**Description**

Confidence Intervals for Differences of Standardized Regression Slopes

**Usage**

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

**Arguments**

<code>object</code>	Object of class <code>rsqbetasandwich</code> .
<code>parm</code>	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.
<code>level</code>	the confidence level required.
<code>...</code>	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)
out <- rsq(std)
confint(out, level = 0.95)
```

---

<code>dif</code>	<i>Differences of Regression Slopes</i>
------------------	---

---

**Description**

Differences of Regression Slopes

**Usage**

```
dif(object, ...)

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

**Arguments**

<code>object</code>	Object used to select a method.
<code>...</code>	additional arguments.

**Author(s)**

Ivan Jacob Agaloos Pesigan

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, ...)
```

**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)
```

---

print.difbetasandwich *Print Method for an Object of Class difbetasandwich*

---

**Description**

Print Method for an Object of Class difbetasandwich

**Usage**

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

**Arguments**

x	Object of class difbetasandwich.
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)
out <- dif(std)
print(out)
```

---

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 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)
out <- rsq(std)
print(out)
```

---

rsq	<i>Estimate Coefficient of Determination (R-Squared and Adjusted R-Squared) and Sampling Covariance Matrix</i>
-----	--

---

**Description**

Estimate Coefficient of Determination (R-Squared and Adjusted R-Squared) and Sampling Covariance Matrix

**Usage**

```
rsq(object, ...)

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

**Arguments**

object	Object used to select a method.
...	additional arguments.

**Author(s)**

Ivan Jacob Agaloos Pesigan

---

summary.betasandwich	<i>Summary Method for an Object of Class betasandwich</i>
----------------------	---

---

**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)
```

---

```
summary.difbetasandwich
```

*Summary Method for an Object of Class difbetasandwich*

---

**Description**

Summary Method for an Object of Class difbetasandwich

**Usage**

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

**Arguments**

object	Object of class difbetasandwich.
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)
out <- dif(std)
summary(out)
```



---

`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

<code>object</code>	Object of class rsqbetasandwich.
<code>alpha</code>	Significance level.
<code>digits</code>	Digits to print.
<code>...</code>	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)  
out <- rsq(std)  
summary(out)
```

---

vcov.betasandwich	<i>Sampling Covariance Matrix of the Standardized Regression Slopes</i>
-------------------	---

---

**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

**Examples**

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

---

vcov.difbetasandwich	<i>Sampling Covariance Matrix of Differences of Standardized Regression Slopes</i>
----------------------	--

---

**Description**

Sampling Covariance Matrix of Differences of Standardized Regression Slopes

**Usage**

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

**Arguments**

object            Object of class difbetasandwich.  
 ...              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)
out <- dif(std)
vcov(out)
```

---

vcov.rsqbetasandwich	<i>Sampling Covariance Matrix of Differences of Standardized Regression Slopes</i>
----------------------	--

---

**Description**

Sampling Covariance Matrix of Differences of Standardized Regression Slopes

**Usage**

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

**Arguments**

object            Object of class rsqbetasandwich.  
 ...              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)
out <- rsq(std)
vcov(out)
```

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