Package ‘betaSandwich’

March 12, 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>.

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

Roxygen list(markdown = TRUE)

Depends R (>= 3.5.0)

Imports methods

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:

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

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 `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.

args Function arguments.

lm_process Processed `lm` 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)
```

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

Usage

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

Arguments

`object`	Object of class `lm`.
`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 `lm` 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()`

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)
```

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 `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.

args Function arguments.

lm_process Processed `lm` 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()`, `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)
```

`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

Examples

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

---

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

Examples

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

coef.rsqbetasandwich *Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared)*

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)
```

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.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 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)
diff <- DiffBetaSandwich(std)
confint(diff, level = 0.95)
```

---

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 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)
rsq <- RSqBetaSandwich(std)
confint(rsq, level = 0.95)
```

`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()`

Examples

```
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)
```

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.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.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

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

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

Examples

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

`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()`

Examples

```
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)
```

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)
```

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)
```

`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.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

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

---

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

Examples

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

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)
```

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, ...)
```

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

Examples

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

Index