Package 'betaDelta'

October 21, 2023

Title Confidence Intervals for Standardized Regression Coefficients

Version 1.0.3.9000

Description Generates confidence intervals for standardized regression coefficients
using delta method standard errors for models fitted by lm()
as described in Yuan and Chan (2011) <doi:10.1007/s11336-011-9224-6>
and Jones and Waller (2015) <doi:10.1007/s11336-013-9380-y>.
A description of the package and code examples
are presented in Pesigan, Sun, and Cheung (2023) <doi:10.1080/00273171.2023.2201277>.

URL https://github.com/jeksterslab/betaDelta,
https://jeksterslab.github.io/betaDelta/

BugReports https://github.com/jeksterslab/betaDelta/issues

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Encoding UTF-8

LazyData true

Roxygen list(markdown = TRUE)

Depends R (>= 3.5.0)

Imports numDeriv

Suggests knitr, rmarkdown, testthat, betaSandwich

RoxygenNote 7.2.3

NeedsCompilation no

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R topics documented:

`BetaDelta` *Estimate Standardized Regression Coefficients and the Corresponding Sampling Covariance Matrix*

Description

Estimate Standardized Regression Coefficients and the Corresponding Sampling Covariance Matrix

Usage

```
BetaDelta(object, type = "mvn", alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `lm`.
`type`	Character string. If `type = "mvn"`, use the multivariate normal-theory approach. If `type = "adf"`, use the asymptotic distribution-free approach.
`alpha`	Numeric vector. Significance level α.

Value

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

call Function call.

args Function arguments.

lm_process Processed `lm` object.

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

Jones, J. A., & Waller, N. G. (2015). The normal-theory and asymptotic distribution-free (ADF) covariance matrix of standardized regression coefficients: Theoretical extensions and finite sample behavior. *Psychometrika*, *80*(2), 365–378. doi:10.1007/s113360139380y

Pesigan, I. J. A., Sun, R. W., & Cheung, S. F. (2023). betaDelta and betaSandwich: Confidence intervals for standardized regression coefficients in R. *Multivariate Behavioral Research*. doi:10.1080/00273171.2023.2201277

Yuan, K.-H., & Chan, W. (2011). Biases and standard errors of standardized regression coefficients. *Psychometrika*, *76*(4), 670–690. doi:10.1007/s1133601192246

See Also

Other Beta Delta Functions: `DiffBetaDelta()`

Examples

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

`coef.betadelta` *Standardized Regression Slopes*

Description

Standardized Regression Slopes

Usage

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

Arguments

`object`	Object of class `betadelta`.
`...`	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 <- BetaDelta(object)
coef(std)
```

---

coef.diffbetadelta *Differences of Standardized Regression Slopes*

Description

Differences of Standardized Regression Slopes

Usage

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

Arguments

object	Object of class diffbetadelta.
...	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 <- BetaDelta(object)
diff <- DiffBetaDelta(std)
coef(diff)
```

confint.betadelta *Confidence Intervals for Standardized Regression Slopes*

Description

Confidence Intervals for Standardized Regression Slopes

Usage

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

Arguments

object	Object of class betadelta.
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 <- BetaDelta(object)
confint(std, level = 0.95)
```

`confint.diffbetadelta` *Confidence Intervals for Differences of Standardized Regression Slopes*

Description

Confidence Intervals for Differences of Standardized Regression Slopes

Usage

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

Arguments

`object`	Object of class `diffbetadelta`.
`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 <- BetaDelta(object)
diff <- DiffBetaDelta(std)
confint(diff)
```

DeltaGeneric *Delta Method Confidence Intervals (Generic)*

Description

Calculates delta method confidence intervals for a function of parameters using a numerical Jacobian.

Usage

```
DeltaGeneric(
  func,
  mu,
  sigmacap,
  n,
  theta = 0,
  alpha = c(0.05, 0.01, 0.001),
  z = TRUE,
  df,
  test = FALSE
)
```

Arguments

func	An R function the input of which is mu. The function should return a vector of any length.
mu	Numeric vector. Input of func.
sigmacap	Numeric vector or matrix. Asymptotic covariance matrix of mu.
n	Sample size.
theta	Numeric vector. Parameter values when the null hypothesis is true.
alpha	Numeric vector. Significance level/s.
z	Logical. If z = TRUE, use the standard normal distribution. If z = FALSE, use the t distribution.
df	Numeric. Degrees of freedom if z = FALSE.
test	Logical. If TRUE, return only the results of hypothesis tests. If FALSE, return both results of hypothesis tests and confidence intervals.

Value

Returns a numeric matrix with the following variables:

est Estimates

se Standard errors

t or z Test statistics

p p value

ci Confidence intervals

Note that if `test = TRUE`, the `ci` columns are omitted.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
g <- function(x) {
  1 / x
}
mu <- 100
sigmasq <- 225
n <- 30
DeltaGeneric(
  func = g,
  mu = mu,
  sigmacap = sigmasq,
  n = n,
  alpha = 0.05
)
```

`DiffBetaDelta` *Estimate Differences of Standardized Slopes and the Corresponding Sampling Covariance Matrix*

Description

Estimate Differences of Standardized Slopes and the Corresponding Sampling Covariance Matrix

Usage

```
DiffBetaDelta(object, alpha = c(0.05, 0.01, 0.001))
```

Arguments

`object`	Object of class `betadelta`, that is, the output of the `BetaDelta()` function.
`alpha`	Numeric vector. Significance level α.

Value

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

call Function call.

fit The argument `object`.

args Function arguments.

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 Delta Functions: `BetaDelta()`

Examples

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaDelta(object)
diff <- DiffBetaDelta(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.betadelta` *Print Method for an Object of Class* `betadelta`

Description

Print Method for an Object of Class `betadelta`

Usage

```
## S3 method for class 'betadelta'
print(x, alpha = NULL, digits = 4, ...)
```

Arguments

`x`	Object of class `betadelta`.
`alpha`	Numeric vector. Significance level α. If `alpha = NULL`, use the argument `alpha` used in `x`.
`digits`	Digits to print.
`...`	additional arguments.

Value

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

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

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

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

Description

Print Method for an Object of Class diffbetadelta

Usage

```
## S3 method for class 'diffbetadelta'
print(x, alpha = NULL, digits = 4, ...)
```

Arguments

x	Object of class diffbetadelta.
alpha	Numeric vector. Significance level α. If alpha = NULL, use the argument alpha used in x.
digits	Digits to print.
...	additional arguments.

Value

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

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

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

summary.betadelta *Summary Method for an Object of Class* betadelta

Description

Summary Method for an Object of Class betadelta

Usage

```
## S3 method for class 'betadelta'
summary(object, alpha = NULL, digits = 4, ...)
```

Arguments

object	Object of class betadelta.
alpha	Numeric vector. Significance level α. If alpha = NULL, use the argument alpha used in object.
digits	Digits to print.
...	additional arguments.

Value

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

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

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

summary.diffbetadelta *Summary Method for an Object of Class* diffbetadelta

Description

Summary Method for an Object of Class diffbetadelta

Usage

```
## S3 method for class 'diffbetadelta'
summary(object, alpha = NULL, digits = 4, ...)
```

Arguments

object	Object of class diffbetadelta.
alpha	Numeric vector. Significance level α. If alpha = NULL, use the argument alpha used in object.
digits	Digits to print.
...	additional arguments.

Value

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

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
std <- BetaDelta(object)
diff <- DiffBetaDelta(std)
summary(diff)
```

vcov.betadelta *Sampling Covariance Matrix of the Standardized Regression Slopes*

Description

Sampling Covariance Matrix of the Standardized Regression Slopes

Usage

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

Arguments

object	Object of class betadelta.
...	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 <- BetaDelta(object)
vcov(std)
```

vcov.diffbetadelta *Sampling Covariance Matrix of Differences of Standardized Regression Slopes*

Description

Sampling Covariance Matrix of Differences of Standardized Regression Slopes

Usage

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

Arguments

object	Object of class diffbetadelta.
...	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 <- BetaDelta(object)
diff <- DiffBetaDelta(std)
vcov(diff)
```

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