

Package ‘betaMC’

August 21, 2023

Title Monte Carlo for Regression Effect Sizes

Version 1.3.0

Description Generates Monte Carlo confidence intervals 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().
'betaMC' combines ideas from Monte Carlo confidence intervals for the indirect effect (Pesigan and Cheung, 2023 <[doi:10.3758/s13428-023-02114-4](https://doi.org/10.3758/s13428-023-02114-4)>) and the sampling covariance matrix of regression coefficients (Dudgeon, 2017 <[doi:10.1007/s11336-017-9563-z](https://doi.org/10.1007/s11336-017-9563-z)>) to generate confidence intervals effect sizes in regression.

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

BugReports <https://github.com/jeksterslab/betaMC/issues>

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NeedsCompilation no

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BetaMC	<i>Estimate Standardized Regression Coefficients and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method</i>
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Description

Estimate Standardized Regression Coefficients and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Usage

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

Arguments

- object Object of class mc, that is, the output of the MC() function.
- alpha Numeric vector. Significance level α .

Details

The vector of standardized regression coefficients ($\hat{\beta}$) is derived from each randomly generated vector of parameter estimates. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of $\hat{\beta}$, where α is the significance level.

Value

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

call Function call.

args Function arguments.

thetahatstar Sampling distribution of $\hat{\beta}$.

vcov Sampling variance-covariance matrix of $\hat{\beta}$.

est Vector of estimated $\hat{\beta}$.

fun Function used ("BetaMC").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Monte Carlo Functions: [DeltaRSqMC\(\)](#), [DiffBetaMC\(\)](#), [MCMI\(\)](#), [MC\(\)](#), [PCorMC\(\)](#), [RSqMC\(\)](#), [SCorMC\(\)](#)

Examples

```
# Data -----
data("nas1982", package = "betaMC")

# Fit Model in lm -----
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# MC -----
mc <- MC(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)

# BetaMC -----
out <- BetaMC(mc, alpha = 0.05)

## Methods -----
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

coef.betamc	<i>Estimated Parameter Method for an Object of Class betamc</i>
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Description

Estimated Parameter Method for an Object of Class betamc

Usage

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

Arguments

object	Object of Class betamc, that is, the output of the BetaMC(), RSqMC(), SCorMC(), DeltaRSqMC(), PCorMC(), or DiffBetaMC() functions.
...	additional arguments.

Value

Returns a vector of estimated parameters.

Author(s)

Ivan Jacob Agaloos Pesigan

confint.betamc	<i>Confidence Intervals Method for an Object of Class betamc</i>
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Description

Confidence Intervals Method for an Object of Class betamc

Usage

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

Arguments

object	Object of Class betamc, that is, the output of the BetaMC(), RSqMC(), SCorMC(), DeltaRSqMC(), PCorMC(), or DiffBetaMC() 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.
...	additional arguments.

Value

Returns a matrix of confidence intervals.

Author(s)

Ivan Jacob Agaloos Pesigan

DeltaRSqMC	<i>Estimate Improvement in R-Squared and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method</i>
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Description

Estimate Improvement in R-Squared and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Usage

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

Arguments

object	Object of class mc, that is, the output of the MC() function.
alpha	Numeric vector. Significance level α .

Details

The vector of improvement in R-squared (ΔR^2) is derived from each randomly generated vector of parameter estimates. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of ΔR^2 , where α is the significance level.

Value

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

- call** Function call.
- args** Function arguments.
- thetahatstar** Sampling distribution of ΔR^2 .
- vcov** Sampling variance-covariance matrix of ΔR^2 .
- est** Vector of estimated ΔR^2 .
- fun** Function used ("DeltaRSqMC").

Author(s)

Ivan Jacob Agaloos Pesigan

See Also

Other Beta Monte Carlo Functions: [BetaMC\(\)](#), [DiffBetaMC\(\)](#), [MCMI\(\)](#), [MC\(\)](#), [PCorMC\(\)](#), [RSqMC\(\)](#), [SCorMC\(\)](#)

Examples

```
# Data -----
data("nas1982", package = "betaMC")

# Fit Model in lm -----
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# MC -----
mc <- MC(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)

# DeltaRSqMC -----
out <- DeltaRSqMC(mc, alpha = 0.05)

## Methods -----
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

DiffBetaMC

Estimate Differences of Standardized Slopes and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Description

Estimate Differences of Standardized Slopes and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Usage

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

Arguments

object	Object of class mc, that is, the output of the MC() function.
alpha	Numeric vector. Significance level α .

Details

The vector of differences of standardized regression slopes is derived from each randomly generated vector of parameter estimates. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of differences of standardized regression slopes, where α is the significance level.

Value

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

call Function call.

args Function arguments.

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 Monte Carlo Functions: [BetaMC\(\)](#), [DeltaRSqMC\(\)](#), [MCMI\(\)](#), [MC\(\)](#), [PCorMC\(\)](#), [RSqMC\(\)](#), [SCorMC\(\)](#)

Examples

```
# Data -----
data("nas1982", package = "betaMC")

# Fit Model in lm -----
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# MC -----
mc <- MC(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)

# DiffBetaMC -----
out <- DiffBetaMC(mc, alpha = 0.05)

## Methods -----
print(out)
summary(out)
coef(out)
vcov(out)
```

```
confint(out, level = 0.95)
```

MC	<i>Generate the Sampling Distribution of Regression Parameters Using the Monte Carlo Method</i>
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Description

Generate the Sampling Distribution of Regression Parameters Using the Monte Carlo Method

Usage

```
MC(
  object,
  R = 20000L,
  type = "hc3",
  g1 = 1,
  g2 = 1.5,
  k = 0.7,
  decomposition = "eigen",
  pd = TRUE,
  tol = 1e-06,
  fixed_x = FALSE,
  seed = NULL
)
```

Arguments

object	Object of class <code>lm</code> .
R	Positive integer. Number of Monte Carlo replications.
type	Character string. Sampling covariance matrix type. Possible values are "mvn", "adf", "hc0", "hc1", "hc2", "hc3", "hc4", "hc4m", and "hc5". type = "mvn" uses the normal-theory sampling covariance matrix. type = "adf" uses the asymptotic distribution-free sampling covariance matrix. type = "hc0" through "hc5" uses different versions of heteroskedasticity-consistent sampling covariance matrix.
g1	Numeric. g1 value for type = "hc4m".
g2	Numeric. g2 value for type = "hc4m".
k	Numeric. Constant for type = "hc5"
decomposition	Character string. Matrix decomposition of the sampling variance-covariance matrix for the data generation. If decomposition = "chol", use Cholesky decomposition. If decomposition = "eigen", use eigenvalue decomposition. If decomposition = "svd", use singular value decomposition.
pd	Logical. If pd = TRUE, check if the sampling variance-covariance matrix is positive definite using tol.

<code>tol</code>	Numeric. Tolerance used for pd.
<code>fixed_x</code>	Logical. If <code>fixed_x = TRUE</code> , treat the regressors as fixed. If <code>fixed_x = FALSE</code> , treat the regressors as random.
<code>seed</code>	Integer. Seed number for reproducibility.

Details

Let the parameter vector of the unstandardized regression model be given by

$$\boldsymbol{\theta} = \{\mathbf{b}, \sigma^2, \text{vech}(\boldsymbol{\Sigma}_{\mathbf{X}\mathbf{X}})\}$$

where \mathbf{b} is the vector of regression slopes, σ^2 is the error variance, and $\text{vech}(\boldsymbol{\Sigma}_{\mathbf{X}\mathbf{X}})$ is the vector of unique elements of the covariance matrix of the regressor variables. The empirical sampling distribution of $\boldsymbol{\theta}$ is generated using the Monte Carlo method, that is, random values of parameter estimates are sampled from the multivariate normal distribution using the estimated parameter vector as the mean vector and the specified sampling covariance matrix using the `type` argument as the covariance matrix. A replacement sampling approach is implemented to ensure that the model-implied covariance matrix is positive definite.

Value

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

call Function call.

args Function arguments.

lm_process Processed `lm` object.

scale Sampling variance-covariance matrix of parameter estimates.

location Parameter estimates.

thetahatstar Sampling distribution of parameter estimates.

fun Function used ("MC").

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

Preacher, K. J., & Selig, J. P. (2012). Advantages of Monte Carlo confidence intervals for indirect effects. *Communication Methods and Measures*, 6(2), 77-98. doi:10.1080/19312458.2012.679848

See Also

Other Beta Monte Carlo Functions: [BetaMC\(\)](#), [DeltaRSqMC\(\)](#), [DiffBetaMC\(\)](#), [MCMC\(\)](#), [PCorMC\(\)](#), [RSqMC\(\)](#), [SCorMC\(\)](#)

Examples

```

# Data -----
data("nas1982", package = "betaMC")

# Fit Model in lm -----
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# MC -----
mc <- MC(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)
mc
# The `mc` object can be passed as the first argument
# to the following functions
#   - BetaMC
#   - DeltaRSqMC
#   - DiffBetaMC
#   - PCorMC
#   - RSqMC
#   - SCorMC

```

MCMC

*Generate the Sampling Distribution of Regression Parameters Using
the Monte Carlo Method for Data with Missing Values*

Description

Generate the Sampling Distribution of Regression Parameters Using the Monte Carlo Method for Data with Missing Values

Usage

```

MCMC(
  object,
  mi,
  R = 20000L,
  type = "hc3",
  g1 = 1,
  g2 = 1.5,
  k = 0.7,
  decomposition = "eigen",
  pd = TRUE,
  tol = 1e-06,
  fixed_x = FALSE,
  seed = NULL
)

```

Arguments

<code>object</code>	Object of class <code>lm</code> .
<code>mi</code>	Object of class <code>mids</code> (output of <code>mice::mice()</code>), object of class <code>amelia</code> (output of <code>Amelia::amelia()</code>), or a list of multiply imputed data sets.
<code>R</code>	Positive integer. Number of Monte Carlo replications.
<code>type</code>	Character string. Sampling covariance matrix type. Possible values are "mvn", "adf", "hc0", "hc1", "hc2", "hc3", "hc4", "hc4m", and "hc5". <code>type = "mvn"</code> uses the normal-theory sampling covariance matrix. <code>type = "adf"</code> uses the asymptotic distribution-free sampling covariance matrix. <code>type = "hc0"</code> through "hc5" uses different versions of heteroskedasticity-consistent sampling covariance matrix.
<code>g1</code>	Numeric. <code>g1</code> value for <code>type = "hc4m"</code> .
<code>g2</code>	Numeric. <code>g2</code> value for <code>type = "hc4m"</code> .
<code>k</code>	Numeric. Constant for <code>type = "hc5"</code>
<code>decomposition</code>	Character string. Matrix decomposition of the sampling variance-covariance matrix for the data generation. If <code>decomposition = "chol"</code> , use Cholesky decomposition. If <code>decomposition = "eigen"</code> , use eigenvalue decomposition. If <code>decomposition = "svd"</code> , use singular value decomposition.
<code>pd</code>	Logical. If <code>pd = TRUE</code> , check if the sampling variance-covariance matrix is positive definite using <code>tol</code> .
<code>tol</code>	Numeric. Tolerance used for <code>pd</code> .
<code>fixed_x</code>	Logical. If <code>fixed_x = TRUE</code> , treat the regressors as fixed. If <code>fixed_x = FALSE</code> , treat the regressors as random.
<code>seed</code>	Integer. Seed number for reproducibility.

Details

Multiple imputation is used to deal with missing values in a data set. The vector of parameter estimates and the corresponding sampling covariance matrix are estimated for each of the imputed data sets. Results are combined to arrive at the pooled vector of parameter estimates and the corresponding sampling covariance matrix. The pooled estimates are then used to generate the sampling distribution of regression parameters. See `MC()` for more details on the Monte Carlo method.

Value

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

call Function call.

args Function arguments.

lm_process Processed `lm` object.

scale Sampling variance-covariance matrix of parameter estimates.

location Parameter estimates.

thetahatstar Sampling distribution of parameter estimates.

fun Function used ("MCMC").

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
- Pesigan, I. J. A., & Cheung, S. F. (2023). Monte Carlo confidence intervals for the indirect effect with missing data. *Behavior Research Methods*. doi:10.3758/s13428023021144
- Preacher, K. J., & Selig, J. P. (2012). Advantages of Monte Carlo confidence intervals for indirect effects. *Communication Methods and Measures*, 6(2), 77-98. doi:10.1080/19312458.2012.679848

See Also

Other Beta Monte Carlo Functions: [BetaMC\(\)](#), [DeltaRSqMC\(\)](#), [DiffBetaMC\(\)](#), [MC\(\)](#), [PCorMC\(\)](#), [RSqMC\(\)](#), [SCorMC\(\)](#)

Examples

```
# Data -----
data("nas1982", package = "betaMC")
nas1982_missing <- mice::ampute(nas1982)$amp # data set with missing values

# Multiple Imputation
mi <- mice::mice(nas1982_missing, m = 5, seed = 42, print = FALSE)

# Fit Model in lm -----
## Note that this does not deal with missing values.
## The fitted model (`object`) is updated with each imputed data
## within the `MCMI()` function.
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982_missing)

# Monte Carlo -----
mc <- MCMI(
  object,
  mi = mi,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)
mc
# The `mc` object can be passed as the first argument
# to the following functions
# - BetaMC
# - DeltaRSqMC
# - DiffBetaMC
# - PCorMC
# - RSqMC
# - SCorMC
```

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.

PCorMC

*Estimate Squared Partial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method***Description**

Estimate Squared Partial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Usage

PCorMC(object, alpha = c(0.05, 0.01, 0.001))

Arguments

object Object of class mc, that is, the output of the MC() function.
alpha Numeric vector. Significance level α .

Details

The vector of squared partial correlation coefficients (r_p^2) is derived from each randomly generated vector of parameter estimates. Confidence intervals are generated by obtaining percentiles corresponding to $100(1-\alpha)\%$ from the generated sampling distribution of r_p^2 , where α is the significance level.

Value

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

call Function call.

args Function arguments.

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 Monte Carlo Functions: [BetaMC\(\)](#), [DeltaRSqMC\(\)](#), [DiffBetaMC\(\)](#), [MCMI\(\)](#), [MC\(\)](#), [RSqMC\(\)](#), [SCorMC\(\)](#)

Examples

```
# Data -----
data("nas1982", package = "betaMC")

# Fit Model in lm -----
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# MC -----
mc <- MC(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)

# PCorMC -----
out <- PCorMC(mc, alpha = 0.05)
```

```
## Methods -----
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

print.betamc	<i>Print Method for an Object of Class betamc</i>
--------------	---------------------------------------------------

Description

Print Method for an Object of Class betamc

Usage

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

Arguments

x	Object of Class betamc, that is, the output of the BetaMC(), RSqMC(), SCorMC(), DeltaRSqMC(), PCorMC(), or DiffBetaMC() functions.
alpha	Numeric vector. Significance level α . If alpha = NULL, use the argument alpha used in x.
digits	Digits to print.
...	additional arguments.

Value

Prints a matrix of estimates, standard errors, number of Monte Carlo replications, and confidence intervals.

Author(s)

Ivan Jacob Agaloos Pesigan

print.mc	<i>Print Method for an Object of Class mc</i>
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Description

Print Method for an Object of Class mc

Usage

```
## S3 method for class 'mc'
print(x, ...)
```

Arguments

x	Object of Class mc.
...	additional arguments.

Value

Prints the first set of simulated parameter estimates and model-implied covariance matrix.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
mc <- MC(object, R = 100)
print(mc)
```

RSqMC	<i>Estimate Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared) and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method</i>
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Description

Estimate Multiple Correlation Coefficients (R-Squared and Adjusted R-Squared) and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Usage

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


Arguments

object	Object of class mc, that is, the output of the MC() function.
alpha	Numeric vector. Significance level α .

Details

R-squared (R^2) and adjusted R-squared (\bar{R}^2) are derived from each randomly generated vector of parameter estimates. 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 α is the significance level.

Value

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

call Function call.

args Function arguments.

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 Monte Carlo Functions: [BetaMC\(\)](#), [DeltaRSqMC\(\)](#), [DiffBetaMC\(\)](#), [MCMI\(\)](#), [MC\(\)](#), [PCorMC\(\)](#), [SCorMC\(\)](#)

Examples

```
# Data -----
data("nas1982", package = "betaMC")

# Fit Model in lm -----
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# MC -----
mc <- MC(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)

# RSqMC -----
out <- RSqMC(mc, alpha = 0.05)
```

```
## Methods -----
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

SCorMC

Estimate Semipartial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Description

Estimate Semipartial Correlation Coefficients and Generate the Corresponding Sampling Distribution Using the Monte Carlo Method

Usage

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

Arguments

object	Object of class <code>mc</code> , that is, the output of the <code>MC()</code> function.
alpha	Numeric vector. Significance level α .

Details

The vector of semipartial correlation coefficients (r_s) is derived from each randomly generated vector of parameter estimates. Confidence intervals are generated by obtaining percentiles corresponding to $100(1 - \alpha)\%$ from the generated sampling distribution of r_s , where α is the significance level.

Value

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

- call** Function call.
- args** Function arguments.
- 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 Monte Carlo Functions: [BetaMC\(\)](#), [DeltaRSqMC\(\)](#), [DiffBetaMC\(\)](#), [MCMC\(\)](#), [MC\(\)](#), [PCorMC\(\)](#), [RSqMC\(\)](#)

Examples

```
# Data -----
data("nas1982", package = "betaMC")

# Fit Model in lm -----
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)

# MC -----
mc <- MC(
  object,
  R = 100, # use a large value e.g., 20000L for actual research
  seed = 0508
)

# SCorMC -----
out <- SCorMC(mc, alpha = 0.05)

## Methods -----
print(out)
summary(out)
coef(out)
vcov(out)
confint(out, level = 0.95)
```

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

Description

Summary Method for an Object of Class betamc

Usage

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

Arguments

object	Object of Class betamc, that is, the output of the BetaMC() , RSqMC() , SCorMC() , DeltaRSqMC() , PCorMC() , or DiffBetaMC() functions.
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 estimates, standard errors, number of Monte Carlo replications, and confidence intervals.

Author(s)

Ivan Jacob Agaloos Pesigan

summary.mc

Summary Method for an Object of Class mc

Description

Summary Method for an Object of Class mc

Usage

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

Arguments

object	Object of Class mc, that is, the output of the MC() function.
digits	Digits to print.
...	additional arguments.

Value

Returns a list with the following elements:

mean Mean of the sampling distribution of $\hat{\theta}$.

var Variance of the sampling distribution of $\hat{\theta}$.

bias Monte Carlo simulation bias.

rmse Monte Carlo simulation root mean square error.

location Location parameter used in the Monte Carlo simulation.

scale Scale parameter used in the Monte Carlo simulation.

Author(s)

Ivan Jacob Agaloos Pesigan

Examples

```
# Fit the regression model
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
mc <- MC(object, R = 100)
summary(mc)
```

vcov.betamc	<i>Sampling Variance-Covariance Matrix Method for an Object of Class betamc</i>
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Description

Sampling Variance-Covariance Matrix Method for an Object of Class betamc

Usage

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

Arguments

object	Object of Class betamc, that is, the output of the BetaMC(), RSqMC(), SCorMC(), DeltaRSqMC(), PCorMC(), or DiffBetaMC() functions.
...	additional arguments.

Value

Returns the variance-covariance matrix of estimates.

Author(s)

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