

Package ‘RESI’

September 6, 2022

Type Package

Title Robust Effect Size Index (RESI) Estimation

Version 1.0.5

Description Summarize model output using a robust effect size index. The index is introduced in Vandekar, Rao, & Blume (2020) <doi:10.1007/s11336-020-09698-2>.

License GPL-3

Encoding UTF-8

LazyData true

Collate 'internal_functions.R' 'summary.resi.R' 'resi.R' 'resi_pe.R'
'Anova.resi.R' 'data.R' 'chisq2S.R' 'f2S.R' 't2S.R' 't2S_alt.R'
'z2S.R' 'z2S_alt.R' 'Rsq2S.R' 'S2Rsq.R' 'S2d.R' 'S2fsq.R'
'd2S.R' 'fsq2S.R' 'plot.R' 'print.R'

Imports aod, car, clubSandwich, lmtest, nlme, regtools, sandwich

Suggests gee, geopack, knitr, lme4, pscl, rmarkdown, splines,
survival, testthat (>= 3.0.0)

RoxygenNote 7.2.0

Depends R (>= 2.10)

Config/testthat/edition 3

NeedsCompilation no

Author Megan Jones [aut, cre],
Kaidi Kang [aut],
Simon Vandekar [aut]

Maintainer Megan Jones <megan.n.taylor@vanderbilt.edu>

Repository CRAN

Date/Publication 2022-09-06 07:00:02 UTC

R topics documented:

anova.resi	2
chisq2S	3

d2S	4
depression	5
f2S	5
fsq2S	6
insurance	7
resi	7
resi_pe	14
Rsquared	18
S2d	19
S2fsq	20
S2Rsquared	21
summary.resi	22
t2S	23
t2S_alt	24
z2S	25
z2S_alt	26

Index	27
--------------	-----------

anova.resi	<i>Anova method for resi objects</i>
------------	--------------------------------------

Description

After running the `resi` function on a fitted model, this function can be used to print the Anova-style table component. If the `resi` function was run with the `'store.boot = TRUE'` option to store the full matrix of bootstrapped estimates, the user can specify a different alpha level for this function's confidence intervals.

Usage

```
## S3 method for class 'resi'
anova(object, alpha = NULL, ...)
```

Arguments

object	an object resulting from <code>resi</code> function
alpha	an optional new specification for the confidence level. Can be vector-valued
...	ignored

Details

The `resi` function uses the `car::Anova` function to compute the Anova table.

Value

Returns an 'anova' object containing the computed Anova-style table

Examples

```
# fit a model
mod = lm(charges ~ bmi + sex, data = RESI::insurance)

# run resi with the store.boot = TRUE option
resi.obj = resi(mod, nboot = 100, store.boot = TRUE, alpha = 0.01)

# run anova, specifying a different alpha level if desired
anova(resi.obj, alpha = 0.05)
```

chisq2S	<i>Compute the robust effect size index estimate from chi-squared statistic.</i>
---------	--

Description

This function computes the robust effect size index from Vandekar, Rao, & Blume (2020). Vector arguments are accepted. If different length arguments are passed they are dealt with in the usual way of R. For mixed effects models, RESI is conditional on the average correlation structure within subjects.

Usage

```
chisq2S(chisq, df, n)
```

Arguments

chisq	The chi-square statistic for the parameter of interest.
df	Number of degrees of freedom of the chi-square statistic.
n	Number of independent samples.

Details

The formula for converting a Chi-square statistic to RESI is:

$$S = \sqrt{\max(0, (chisq - df)/n)}$$

Value

Returns a scalar or vector argument of the the robust effect size index estimate.

Examples

```
# obtain Chi-sq value by fitting an lm and running a Wald test
mod = lm(charges ~ region * age + bmi + sex, data = RESI::insurance)

# run a Wald test with robust variance
wt = lmtest::waldtest(mod, vcov = sandwich::vcovHC, test = 'Chisq')
```

```
# get Chi-sq value and degrees of freedom
chisq = wt$Chisq[2]
df = abs(wt$Df[2])

# run chisq2S to convert to RESI
chisq2S(chisq, df = df, n = nrow(mod$model))
```

d2S

Covert Cohen's d to lSI

Description

Converts Cohen's d robust effect size index (S) using the formula from Vandekar, Rao, & Blume (2020).

Usage

```
d2S(d, pi = 0.5)
```

Arguments

d Numeric, value of Cohen's d .

pi Numeric, the sampling proportions.

Details

The pi parameter comes from the fact that Cohen's d doesn't account for unequal sample proportions in the population, but S does.

The default is set to a natural value $1/2$, which corresponds to a case control design, for example, where sampling proportions always are controlled by the experimenter.

The formula to convert Cohen's d to S is:

$$S = d / \sqrt{(1/\pi + 1/(1 - \pi))}$$

Value

Returns an estimate the robust effect size index

Examples

```
# Consider an experiment with equal sampling proportions and a medium effect size
# corresponding to a Cohen's d of 0.5.
# convert to RESI (S)
d2S(d = 0.5)

# This corresponds to a RESI of 0.25.
```

depression	<i>Depression Treatment Data</i>
------------	----------------------------------

Description

A longitudinal dataset comparing two treatments for depression.

Usage

depression

Format

A data frame with 1020 rows and 5 variables:

diagnose diagnosed depression severity

drug treatment; standard or new

id patient id

time time point of treatment

depression depression response at time of treatment. 1 = Normal, 0 = Abnormal

Source

<http://static.lib.virginia.edu/statlab/materials/data/depression.csv>

References

Agresti, A. (2002). *Categorical Data Analysis*. Wiley, 2nd Edition.

f2S	<i>Compute the robust effect size index estimate from F-statistic</i>
-----	---

Description

This function computes the robust effect size index from Vandekar, Rao, & Blume (2020). Vector arguments are accepted. If different length arguments are passed they are dealt with in the usual way of R.

Usage

f2S(f, df, rdf)

Arguments

f The F statistic for the parameter of interest.
df Number of degrees of freedom of the chi-square statistic.
rdf Model residual degrees of freedom or number of independent samples.

Details

The formula for converting an F statistic to S is:

$$S = \sqrt{\max(0, (f * df * (rdf - 2) / (rdf - 1) / rdf))}$$

Value

Returns a scalar or vector argument of the the robust effect size index estimate. # to obtain example F values, first fit a glm mod = glm(charges ~ region * age + bmi + sex, data = RESI::insurance)
run Anova, using a robust variance-covariance function # get the F values and Df values fs = car::Anova(mod, vcov. = sandwich::vcovHC)\$F dfs = car::Anova(mod, vcov. = sandwich::vcovHC)\$Df
get RESI estimates f2S(fs, df = dfs, rdf = mod\$df.residual)

fsq2S

*Covert Cohen's f^2 to S***Description**

Converts Cohen's f^2 to robust effect size index (S) using the formula from Vandekar, Rao, & Blume (2020).

Usage

```
fsq2S(fsq)
```

Arguments

fsq Numeric, value of Cohen's f^2 .

Details

The formula for the conversion is:

$$S = \sqrt{f^2}$$

Value

Returns an estimate the robust effect size index

Examples

```
# consider a moderate effect size of f^2 = 0.3
fsq2S(0.3)
# This corresponds to a RESI of 0.5477226
```

insurance

US Health Insurance Data

Description

A dataset with 1338 observations on health insurance charges and demographic factors.

Usage

insurance

Format

A data frame with 1338 rows and 7 variables:

age age of primary beneficiary in years

sex insurance contractor sex, male/female

bmi body mass index

children number of dependents

smoker smoker/non-smoker

region beneficiary's region of US

charges individual medical costs billed by health insurance

Source

<https://www.kaggle.com/datasets/teertha/ushealthinsurancedataset>

resi

Robust Effect Size Index (RESI) point and interval estimation for models

Description

This function will estimate the robust effect size (RESI) from Vandekar, Rao, & Blume (2020) and its confidence interval in various ways for a fitted model object. The overall RESI is estimated via a Wald test. RESI is (optionally) estimated for each factor in coefficients-style table. RESI is (optionally) estimated for each variable/interaction in an Anova-style table for models with existing Anova methods. CIs can be calculated using either non-parametric or Bayesian bootstrapping.

Usage

```
resi(model.full, ...)  
  
## Default S3 method:  
resi(  
  model.full,  
  model.reduced = NULL,  
  data,  
  anova = TRUE,  
  coefficients = TRUE,  
  nboot = 1000,  
  vcovfunc = sandwich::vcovHC,  
  alpha = 0.05,  
  store.boot = FALSE,  
  Anova.args = list(),  
  vcov.args = list(),  
  unbiased = TRUE,  
  ...  
)  
  
## S3 method for class 'glm'  
resi(  
  model.full,  
  model.reduced = NULL,  
  data,  
  anova = TRUE,  
  coefficients = TRUE,  
  nboot = 1000,  
  vcovfunc = sandwich::vcovHC,  
  alpha = 0.05,  
  store.boot = FALSE,  
  Anova.args = list(),  
  vcov.args = list(),  
  unbiased = TRUE,  
  ...  
)  
  
## S3 method for class 'lm'  
resi(  
  model.full,  
  model.reduced = NULL,  
  data,  
  anova = TRUE,  
  coefficients = TRUE,  
  nboot = 1000,  
  boot.method = "nonparam",  
  vcovfunc = sandwich::vcovHC,  
  alpha = 0.05,
```



```
    store.boot = FALSE,
    Anova.args = list(),
    vcov.args = list(),
    unbiased = TRUE,
    ...
)

## S3 method for class 'nls'
resi(
  model.full,
  model.reduced = NULL,
  data,
  coefficients = TRUE,
  nboot = 1000,
  boot.method = "nonparam",
  vcovfunc = regtools::nlshc,
  alpha = 0.05,
  store.boot = FALSE,
  vcov.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'survreg'
resi(
  model.full,
  model.reduced = NULL,
  data,
  anova = TRUE,
  coefficients = TRUE,
  nboot = 1000,
  vcovfunc = vcov,
  alpha = 0.05,
  store.boot = FALSE,
  Anova.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'coxph'
resi(
  model.full,
  model.reduced = NULL,
  data,
  anova = TRUE,
  coefficients = TRUE,
  nboot = 1000,
  vcovfunc = vcov,
```

```
    alpha = 0.05,
    store.boot = FALSE,
    Anova.args = list(),
    unbiased = TRUE,
    ...
)

## S3 method for class 'hurdle'
resi(
  model.full,
  model.reduced = NULL,
  data,
  coefficients = TRUE,
  nboot = 1000,
  vcovfunc = sandwich::sandwich,
  alpha = 0.05,
  store.boot = FALSE,
  vcov.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'zeroinfl'
resi(
  model.full,
  model.reduced = NULL,
  data,
  coefficients = TRUE,
  nboot = 1000,
  vcovfunc = sandwich::sandwich,
  alpha = 0.05,
  store.boot = FALSE,
  vcov.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'geeglm'
resi(model.full, alpha = 0.05, nboot = 1000, ...)

## S3 method for class 'gee'
resi(model.full, data, alpha = 0.05, nboot = 1000, ...)

## S3 method for class 'lme'
resi(
  model.full,
  alpha = 0.05,
  nboot = 1000,
```

```

vcovfunc = clubSandwich::vcovCR,
vcov.args = list(),
...
)

```

Arguments

<code>model.full</code>	lm, glm, nls, survreg, coxph, hurdle, zeroinfl, gee, geeglm or lme model object.
<code>...</code>	Ignored.
<code>model.reduced</code>	Fitted model object of same type as <code>model.full</code> . By default 'NULL'; the same model as the full model but only having intercept.
<code>data</code>	Data.frame or object coercible to data.frame of <code>model.full</code> data (required for some model types).
<code>anova</code>	Logical, whether to produce an Anova table with the RESI columns added. By default = 'TRUE'.
<code>coefficients</code>	Logical, whether to produce a coefficients (summary) table with the RESI columns added. By default = 'TRUE'.
<code>nboot</code>	Numeric, the number of bootstrap replicates. By default, 1000.
<code>vcovfunc</code>	The variance estimator function for constructing the Wald test statistic. By default, <code>sandwich::vcovHC</code> (the robust (sandwich) variance estimator).
<code>alpha</code>	Numeric, significance level of the constructed CIs. By default, 0.05.
<code>store.boot</code>	Logical, whether to store all the bootstrapped estimates. By default, 'FALSE'.
<code>Anova.args</code>	List, additional arguments to be passed to Anova function.
<code>vcov.args</code>	List, additional arguments to be passed to <code>vcovfunc</code> .
<code>unbiased</code>	Logical, whether to use the unbiased or alternative T/Z statistic to RESI conversion. By default, 'TRUE'. See details.
<code>boot.method</code>	String, which type of bootstrap to use: 'nonparam' = non-parametric bootstrap (default); 'bayes' = Bayesian bootstrap.

Details

The RESI, denoted as S , is applicable across many model types. It is a unitless index and can be easily be compared across models. The RESI can also be converted to Cohen's d ([S2d](#)) under model homoskedasticity.

This function computes the RESI point estimates and bootstrapped confidence intervals based on Chi-square, F, T, or Z statistics. The robust (sandwich) variance is used by default, allowing for consistency under model-misspecification. The RESI is related to the non-centrality parameter of the test statistic. The RESI estimate is consistent for all four (Chi-square, F, T, and Z) types of statistics used. The Chi-square and F-based calculations rely on asymptotic theory, so they may be biased in small samples. When possible, the T and Z statistics are used. There are two formulas for both the T and Z statistic conversion. The first (default, `unbiased = TRUE`) are based on solving the expected value of the T or Z statistic for the RESI. The alternative is based on squaring the T or Z statistic and using the F or Chi-square statistic conversion. Both of these methods are consistent, but the alternative exhibits a notable amount of finite sample bias. The alternative may be appealing

because its absolute value will be equal to the RESI based on the F or Chi-square statistic. The RESI based on the Chi-Square and F statistics is always greater than or equal to 0. The type of statistic used is listed with the output. See [f2S](#), [chisq2S](#), [t2S](#), [z2S](#), [t2S_alt](#), and [z2S_alt](#) for more details on the formulas.

For most `lm` and `nls` model types, there is a Bayesian bootstrap option available as an alternative to the default, standard non-parametric bootstrap. The interpretation of a Bayesian bootstrapped interval is similar to that of a credible interval.

Certain model types require the data used for the model be entered as an argument. These are: `nls`, `survreg`, and `coxph`. Additionally, if a model includes certain functions (splines, factor, I), the data needs to be provided.

If running into convergence issues with `nls` models, it is advised to refit the `nls` model with starting values equal to the estimates provided by the model and then try rerunning `resi`.

Value

Returns a list that includes function arguments, RESI point estimates, and confidence intervals in coefficients/anova-style tables

Methods (by class)

- `default`: RESI point and interval estimation for models
- `glm`: RESI point and interval estimation for models
- `lm`: RESI point and interval estimation for `lm` models
- `nls`: RESI point and interval estimation for `nls` models
- `survreg`: RESI point and interval estimation for `survreg` models
- `coxph`: RESI point and interval estimation for `coxph` models
- `hurdle`: RESI point and interval estimation for hurdle models
- `zeroinfl`: RESI point and interval estimation for `zeroinfl` models
- `geeglm`: RESI point and interval estimation for GEE models
- `gee`: RESI point and interval estimation for GEE models
- `lme`: RESI point and interval estimation for LME (`nlme`) models

References

Vandekar S, Tao R, Blume J. A Robust Effect Size Index. *Psychometrika*. 2020 Mar;85(1):232-246. doi: 10.1007/s11336-020-09698-2.

Kang, K., Armstrong, K., Avery, S., McHugo, M., Heckers, S., & Vandekar, S. (2021). Accurate confidence interval estimation for non-centrality parameters and effect size indices. *arXiv preprint arXiv:2111.05966*.

See Also

[resi_pe](#), [vcovHC](#), [nlshc](#), [f2S](#), [chisq2S](#), [z2S](#), [t2S](#)

Examples

```

## for timing purposes, a small number of bootstrap replicates is used in the
## examples. Run them with a higher or default `nboot` argument for better performance

## RESI on a linear model
# fit linear model
mod = lm(charges ~ region * age + bmi + sex, data = RESI::insurance)

# run resi on fitted model with desired number of bootstrap replicates
resi(mod, nboot = 50)

# fit a reduced model for comparison
mod.red = lm(charges ~ bmi, data = RESI::insurance)

# running resi and including the reduced model will provide almost the exact same
# output as not including a reduced model. The difference is that the "overall"
# portion of the output will compare the full model to the reduced model.
# The "summary" and "anova" RESI estimates will be the same. (The bootstrapped
# confidence intervals may differ.)
resi(model.full = mod, model.reduced = mod.red, nboot = 10)

# for some model types and formula structures, data argument is required
library(splines)
# fit logistic regression model with splines
mod = glm(smoker ~ ns(age, df = 3) + region, data = RESI::insurance, family = "binomial")

# store bootstrap results for calculating different CIs later
# specify additional arguments to the variance-covariance function via vcov.args
resi.obj = resi(mod, data = RESI::insurance, store.boot = TRUE, alpha = 0.01,
vcov.args = list(type = "HC0"), nboot = 25)
summary(resi.obj, alpha = c(0.1))
car::Anova(resi.obj, alpha = 0.1)

# the result of resi, as well as the summary or Anova of a `resi` object can be plotted
# if the resi object was created with the store.boot = `TRUE` option, any alpha
# can be specified
plot(resi.obj, alpha = 0.05)
# if the variable names on the y-axis are too long, you can reduce their size with
# the ycex.axis argument (or use regular common solutions like changing the margins)
plot(resi.obj, alpha = 0.05, ycex.axis = 0.5)

## RESI on a survival model with alternate Z2S
# load survival library
library(survival)

# fit coxph model on example data from survival package
# Note: for survival models, you need to specify robust variance in the model
# creation. resi will ignore the vcovfunc argument for this reason.
mod.coxph = coxph(Surv(time, status) ~ age + sex + wt.loss, data=lung, robust = TRUE)

# run resi on the model
# to use the alternative Z to RESI formula (which is equal in absolute value to the

```

```
# chi-square to RESI (S) formula), specify unbiased = FALSE.
resi(mod.coxph, data = lung, unbiased = FALSE, nboot = 10)
```

resi_pe

Robust Effect Size Index (RESI) Point Estimation

Description

This function will estimate the robust effect size (RESI) from Vandekar, Rao, & Blume (2020). The overall RESI is estimated via a Wald test. RESI is (optionally) estimated for each factor in coefficients-style table. RESI is (optionally) estimated for each variable/interaction in an Anova-style table for models with existing Anova methods. This function is the building block for the [resi](#) function.

Usage

```
resi_pe(model.full, ...)

## Default S3 method:
resi_pe(
  model.full,
  model.reduced = NULL,
  data,
  coefficients = TRUE,
  vcovfunc = sandwich::vcovHC,
  Anova.args = list(),
  vcov.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'glm'
resi_pe(
  model.full,
  model.reduced = NULL,
  data,
  anova = TRUE,
  coefficients = TRUE,
  vcovfunc = sandwich::vcovHC,
  Anova.args = list(),
  vcov.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'lm'
```

```
resi_pe(  
  model.full,  
  model.reduced = NULL,  
  data,  
  anova = TRUE,  
  coefficients = TRUE,  
  vcovfunc = sandwich::vcovHC,  
  Anova.args = list(),  
  vcov.args = list(),  
  unbiased = TRUE,  
  ...  
)  
  
## S3 method for class 'nls'  
resi_pe(  
  model.full,  
  model.reduced = NULL,  
  data,  
  coefficients = TRUE,  
  vcovfunc = regtools::nlshc,  
  vcov.args = list(),  
  unbiased = TRUE,  
  ...  
)  
  
## S3 method for class 'survreg'  
resi_pe(  
  model.full,  
  model.reduced = NULL,  
  data,  
  anova = TRUE,  
  coefficients = TRUE,  
  vcovfunc = vcov,  
  Anova.args = list(),  
  unbiased = TRUE,  
  ...  
)  
  
## S3 method for class 'coxph'  
resi_pe(  
  model.full,  
  model.reduced = NULL,  
  data,  
  anova = TRUE,  
  coefficients = TRUE,  
  vcovfunc = vcov,  
  Anova.args = list(),  
  unbiased = TRUE,  
  ...  
)
```

```

    ...
  )

## S3 method for class 'hurdle'
resi_pe(
  model.full,
  model.reduced = NULL,
  data,
  coefficients = TRUE,
  vcovfunc = sandwich::sandwich,
  vcov.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'zeroinfl'
resi_pe(
  model.full,
  model.reduced = NULL,
  data,
  coefficients = TRUE,
  vcovfunc = sandwich::sandwich,
  vcov.args = list(),
  unbiased = TRUE,
  ...
)

## S3 method for class 'geeglm'
resi_pe(model.full, ...)

## S3 method for class 'gee'
resi_pe(model.full, ...)

## S3 method for class 'lme'
resi_pe(model.full, vcovfunc = clubSandwich::vcovCR, vcov.args = list(), ...)

## S3 method for class 'lmerMod'
resi_pe(model.full, vcovfunc = clubSandwich::vcovCR, vcov.args = list(), ...)

```

Arguments

<code>model.full</code>	lm, glm, nls, survreg, coxph, hurdle, zeroinfl, gee, geeglm or lme model object.
<code>...</code>	Ignored.
<code>model.reduced</code>	Fitted model object of same type as <code>model.full</code> . By default 'NULL'; the same model as the full model but only having intercept.
<code>data</code>	Data.frame or object coercible to data.frame of <code>model.full</code> data (required for some model types).

<code>coefficients</code>	Logical, whether to produce a coefficients (summary) table with the RESI columns added. By default = 'TRUE'.
<code>vcovfunc</code>	The variance estimator function for constructing the Wald test statistic. By default, <code>sandwich::vcovHC</code> (the robust (sandwich) variance estimator).
<code>Anova.args</code>	List, additional arguments to be passed to Anova function.
<code>vcov.args</code>	List, additional arguments to be passed to <code>vcovfunc</code> .
<code>unbiased</code>	Logical, whether to use the unbiased or alternative T/Z statistic to RESI conversion. By default, 'TRUE'. See details.
<code>anova</code>	Logical, whether to produce an Anova table with the RESI columns added. By default = 'TRUE'.

Details

The Robust Effect Size Index (RESI) is an effect size measure based on M-estimators. This function is called by `resi` a specified number of times to form bootstrapped confidence intervals. Called by itself, this function will only calculate point estimates.

The RESI, denoted as S , is applicable across many model types. It is a unitless index and can be easily be compared across models. The RESI can also be converted to Cohen's d ([S2d](#)) under model homoskedasticity.

The RESI is related to the non-centrality parameter of the test statistic. The RESI estimate is consistent for all four (Chi-square, F, T, and Z) types of statistics used. The Chi-square and F-based calculations rely on asymptotic theory, so they may be biased in small samples. When possible, the T and Z statistics are used. There are two formulas for both the T and Z statistic conversion. The first (default, `unbiased = TRUE`) are based on solving the expected value of the T or Z statistic for the RESI. The alternative is based on squaring the T or Z statistic and using the F or Chi-square statistic conversion. Both of these methods are consistent, but the alternative exhibits a notable amount of finite sample bias. The alternative may be appealing because its absolute value will be equal to the RESI based on the F or Chi-square statistic. The RESI based on the Chi-Square and F statistics is always greater than or equal to 0. The type of statistic used is listed with the output. See [f2S](#), [chisq2S](#), [t2S](#), [z2S](#), [t2S_alt](#), and [z2S_alt](#) for more details on the formulas.

Value

Returns a list containing RESI point estimates

Methods (by class)

- `default`: RESI point estimation
- `glm`: RESI point estimation for generalized linear models
- `lm`: RESI point estimation for linear models
- `nls`: RESI point estimation for nonlinear least squares models
- `survreg`: RESI point estimation for `survreg`
- `coxph`: RESI point estimation for `coxph` models
- `hurdle`: RESI point estimation for hurdle models
- `zeroinfl`: RESI point estimation for `zeroinfl` models

- `geeglm`: RESI point estimation for `geeglm` object
- `gee`: RESI point estimation for `gee` object
- `lme`: RESI point estimation for `lme` object
- `lmerMod`: RESI point estimation for `lmerMod` object

References

Vandekar S, Tao R, Blume J. A Robust Effect Size Index. *Psychometrika*. 2020 Mar;85(1):232-246. doi: 10.1007/s11336-020-09698-2.

Examples

```
# This function produces point estimates for the RESI. The resi function will
# provide the same point estimates but adds confidence intervals. See resi for
# more detailed examples.

## resi_pe for a linear model
# fit linear model
mod <- lm(charges ~ region * age + bmi + sex, data = RESI::insurance)
# run resi_pe on the model
resi_pe(mod)

# if you want to have RESI estimates in the coefficient table that are equal in absolute
# value to those in the Anova table (except for those with >1 df and/or included in other
# interaction terms), you can specify unbiased = FALSE to use the alternate conversion.
resi_pe(mod, unbiased = FALSE)
```

Rsqr2S

Covert R^2 to S

Description

Converts R^2 , the partial coefficient of determination, to robust effect size index (S) using the formula from Vandekar, Rao, & Blume (2020).

Usage

```
Rsqr2S(Rsq)
```

Arguments

```
Rsqr      Numeric, R^2
```

Details

The formula for the conversion is:

$$S = \sqrt{((-R^2)/(R^2 - 1))}$$

Value

Returns an estimate of R^2 based on the RESI

Examples

```
# consider a moderate effect size of  $R^2 = 0.1$ 
Rsquared(0.1)
# this corresponds to a RESI of 0.333
```

S2d

Convert S to Cohen's d

Description

Converts the robust effect size index (S) to Cohen's d using the formula from Vandekar, Rao, & Blume (2020).

Usage

```
S2d(S, pi = 0.5)
```

Arguments

S	Numeric, the robust effect size index.
pi	Numeric, the sampling proportions.

Details

The pi parameter comes from the fact that Cohen's d doesn't account for unequal sample proportions in the population, but S does.

The default is set to a natural value 1/2, which corresponds to a case control design, for example, where sampling proportions always are controlled by the experimenter.

The formula for the conversion is:

$$d = |S * \sqrt{(1/\pi + 1/(1 - \pi))}|$$

Value

Returns an estimate of Cohen's d based on the RESI.

Examples

```
# fit a simple linear regression with a binary predictor
mod = lm(charges ~ sex, data = RESI::insurance)

# calculate t-value
t = summary(mod)$coefficients[2, "t value"]

# calculate RESI (S)
S = t2S(t, n = 1338, rdf = 1336)

# determine sample proportions
pi = length(which(RESI::insurance[, "sex"]=="male"))/1338

# convert S to Cohen's d
S2d(S = S, pi = pi)
```

S2fsq

Covert S to Cohen's f²

Description

Converts robust effect size index (S) to Cohen's f^2 (effect size for multiple regression) using the formula from Vandekar, Rao, & Blume (2020).

Usage

```
S2fsq(S)
```

Arguments

S Numeric, the robust effect size index.

Details

The formula for the conversion is:

$$f^2 = S^2$$

Value

Returns an estimate of Cohen's f^2 based on the RESI

Examples

```
# fit a linear regression model with continuous outcome and predictor
mod = lm(charges ~ age, data = RESI::insurance)

# obtain t value for calculating RESI
t = summary(mod)$coefficients[2, "t value"]

# calculate RESI
S = t2S(t, n = 1338, rdf = 1336)

# convert to f^2
S2fsq(S)
```

S2Rsq

Covert S to R^2

Description

Converts robust effect size index (S) to R², the partial coefficient of determination, using the formula from Vandekar, Rao, & Blume (2020).

Usage

```
S2Rsq(S)
```

Arguments

S Numeric, the robust effect size index.

Details

The formula for the conversion is:

$$R^2 = S^2 / (1 + S^2)$$

Value

Returns an estimate of R² based on the RESI

Examples

```
# fit a simple linear regression with a binary predictor
mod = lm(charges ~ sex, data = RESI::insurance)

# calculate t-value
t = summary(mod)$coefficients[2, "t value"]

# calculate RESI (S)
S = t2S(t, n = 1338, rdf = 1336)
```

```
# convert S to R^2
S2Rsq(S)
```

`summary.resi`*Summary method for resi objects*

Description

After running the `resi` function on a fitted model, this function can be used to print the coefficients table component. If the `resi` function was run with the `'store.boot = TRUE'` option to store the full matrix of bootstrapped estimates, the user can specify a different alpha level for this function's confidence intervals.

Usage

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

Arguments

<code>object</code>	an object resulting from <code>resi</code> function
<code>alpha</code>	an optional new specification for the confidence level. Can be vector-valued
<code>...</code>	ignored

Value

Returns a `'summary.resi'` object containing the computed coefficients table

Examples

```
# fit a model
mod = lm(charges ~ bmi + sex, data = RESI::insurance)

# run resi with the store.boot = TRUE option
resi.obj = resi(mod, nboot = 100, store.boot = TRUE, alpha = 0.01)

# run summary, specifying a different alpha level if desired
summary(resi.obj, alpha = 0.05)
```

t2S *Compute the robust effect size index estimate from t statistic (default)*

Description

This function computes the robust effect size index from Vandekar, Rao, & Blume (2020). Vector arguments are accepted. If different length arguments are passed they are dealt with in the usual way of R.

Usage

```
t2S(t, n, rdf)
```

Arguments

t	The t statistic for the parameter of interest.
n	Number of independent samples.
rdf	Model residual degrees of freedom/degrees of freedom of the T statistic.

Details

This function computes S, the RESI, from a T statistic using the default formula. There is another function, `t2S_alt`, that uses an alternative formula. This function's formula is derived by solving the expected value of the T statistic for S. It is unbiased and consistent.

The formula for the conversion is:

$$S = (t * \sqrt{2}) * \Gamma(rdf/2) / (\sqrt{(n * rdf)} * \Gamma((rdf - 1)/2))$$

Value

Returns a scalar or vector argument of the the robust effect size index estimate.

Examples

```
# to obtain t values, first fit a lm
mod = lm(charges ~ region * age + bmi + sex, data = RESI::insurance)
# run lmtest::coefstest to get t values, using a robust variance-covariance formula
ts = lmtest::coefstest(mod, vcov. = sandwich::vcovHC[, 't value'])

# get RESI estimates
t2S(ts, n = nrow(RESI::insurance), rdf = mod$df.residual)
```

t2S_alt	<i>Compute the robust effect size index estimate from t statistic (alternative)</i>
---------	---

Description

This function computes the robust effect size index from Vandekar, Rao, & Blume (2020). Vector arguments are accepted. If different length arguments are passed they are dealt with in the usual way of R.

Usage

```
t2S_alt(t, rdf)
```

Arguments

t	The t statistic for the parameter of interest.
rdf	Model residual degrees of freedom or number of independent samples.

Details

This function computes S, the RESI, from a T statistic using the alternative formula. There is another function, `t2S`, that is the default for `resi`. This function's formula is derived by squaring the T statistic and using the `f2S` formula. This function may be appealing for its intuitive relationship to the F statistic; the absolute value of RESI estimates using this formula will be equal to a RESI estimate using an F statistic for the same model. However, this estimator does have finite sample bias, which is an important consideration for the coverage of the bootstrapping that `resi` uses.

The formula for this conversion is:

$$\sqrt{\max(0, (t^2 * (rdf - 2) / (rdf - 1)) / rdf)}$$

Value

Returns a scalar or vector argument of the the robust effect size index estimate.

Examples

```
# to obtain t values, first fit a lm
mod = lm(charges ~ region * age + bmi + sex, data = RESI::insurance)
# run lmtest::coeftest to get t values, using a robust variance-covariance formula
ts = lmtest::coeftest(mod, vcov. = sandwich::vcovHC)[,'t value']

# get RESI estimates
t2S_alt(ts, rdf = mod$df.residual)
```

`z2S`*Compute the robust effect size index estimate from Z statistic*

Description

This function computes the robust effect size index from Vandekar, Rao, & Blume (2020). Vector arguments are accepted. If different length arguments are passed they are dealt with in the usual way of R.

Usage

```
z2S(z, n)
```

Arguments

<code>z</code>	The Z statistic for the parameter of interest.
<code>n</code>	Number of independent samples.

Details

This function computes S , the RESI, from a Z statistic using the default formula. There is another function, `z2S_alt`, that uses an alternative formula. This function's formula is derived by solving the expected value of the Z statistic for S . It is unbiased and consistent.

The formula for this conversion is:

$$S = Z / \sqrt{(n)}$$

Value

Returns a scalar or vector argument of the the robust effect size index estimate.

Examples

```
# to obtain example z values, first fit a glm
mod = glm(charges ~ region * age + bmi + sex, data = RESI::insurance)
# run coefstest to get z values using a robust variance-covariance function
zs = lmtest::coefstest(mod, vcov. = sandwich::vcovHC)[, 'z value']

# get RESI estimates
z2S(zs, n = nrow(RESI::insurance))
```

z2S_alt	<i>Compute the robust effect size index estimate from Z statistic (alternative)</i>
---------	---

Description

This function computes the robust effect size index from Vandekar, Rao, & Blume (2020). Vector arguments are accepted. If different length arguments are passed they are dealt with in the usual way of R.

Usage

```
z2S_alt(z, n)
```

Arguments

z	The Z statistic for the parameter of interest.
n	Number of independent samples.

Details

This function computes S, the RESI, from a Z statistic using the alternative formula. There is another function, `z2S`, that is the default for `resi`. This function's formula is derived by squaring the Z statistic and using the `chisq2S` formula. This function may be appealing for its intuitive relationship to the Chi-square statistic; the absolute value of RESI estimates using this formula will be equal to a RESI estimate using a Chi-square statistic for the same model. However, this estimator does have finite sample bias, which is an important consideration for the coverage of the bootstrapping that `resi` uses.

The formula for this conversion is:

$$\sqrt{\max(0, (Z^2 - 1)/n)} * \text{sign}(Z)$$

Value

Returns a scalar or vector argument of the the robust effect size index estimate.

Examples

```
# to obtain example z values, first fit a glm
mod = glm(charges ~ region * age + bmi + sex, data = RESI::insurance)
# run coeftest to get z values using a robust variance-covariance function
zs = lmtest::coeftest(mod, vcov. = sandwich::vcovHC)[,'z value']

# get RESI estimates
z2S(zs, n = nrow(RESI::insurance))
```

Index

* RESI functions

resi, 7

* datasets

depression, 5

insurance, 7

Anova, 11

anova.resi, 2

chisq2S, 3, 12, 17, 26

d2S, 4

depression, 5

f2S, 5, 12, 17, 24

fsq2S, 6

insurance, 7

n1shc, 12

resi, 2, 7, 14, 17, 22, 24, 26

resi_pe, 12, 14

Rsq2S, 18

S2d, 11, 17, 19

S2fsq, 20

S2Rsq, 21

summary.resi, 22

t2S, 12, 17, 23, 24

t2S_alt, 12, 17, 23, 24

vcovHC, 12

z2S, 12, 17, 25, 26

z2S_alt, 12, 17, 25, 26