

Package ‘clubSandwich’

December 1, 2016

Title Cluster-Robust (Sandwich) Variance Estimators with Small-Sample Corrections

Version 0.2.2

Description Provides several cluster-robust variance estimators (i.e., sandwich estimators) for ordinary and weighted least squares linear regression models, including the bias-reduced linearization estimator introduced by Bell and McCaffrey (2002) <<http://www.statcan.gc.ca/pub/12-001-x/2002002/article/9058-eng.pdf>> and developed further by Pustejovsky and Tipton (2016) <DOI:10.1080/07350015.2016.1247004>. The package includes functions for estimating the variance-covariance matrix and for testing single- and multiple-contrast hypotheses based on Wald test statistics. Tests of single regression coefficients use Satterthwaite or saddle-point corrections. Tests of multiple-contrast hypotheses use an approximation to Hotelling's T-squared distribution. Methods are provided for a variety of fitted models, including `lm()`, `plm()` (from package 'plm'), `gls()` and `lme()` (from 'nlme'), `robu()` (from 'robumeta'), and `rma.uni()` and `rma.mv()` (from 'metafor').

URL <https://github.com/jepusto/clubSandwich>

BugReports <https://github.com/jepusto/clubSandwich/issues>

Depends R (>= 3.0.0)

License GPL-3

VignetteBuilder knitr

LazyData true

Imports stats, sandwich

Suggests Formula, knitr, car, metafor, robumeta, nlme, mlmRev, AER, plm, testthat, rmarkdown

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AchievementAwardsRCT *Achievement Awards Demonstration program*

Description

Data from a randomized trial of the Achievement Awards Demonstration program, reported in Angrist & Lavy (2009).

Usage

AchievementAwardsRCT

Format

A data frame with 16526 rows and 21 variables:

school_id Fictitious school identification number

school_type Factor identifying the school type (Arab religious, Jewish religious, Jewish secular)

pair Number of treatment pair. Note that 7 is a triple.

treated Indicator for whether school was in treatment group

year Cohort year

student_id Fictitious student identification number

sex Factor identifying student sex

siblings Number of siblings
immigrant Indicator for immigrant status
father_ed Father's level of education
mother_ed Mother's level of education
Bagrut_status Indicator for Bagrut attainment
attempted Number of Bagrut units attempted
awarded Number of Bagrut units awarded
achv_math Indicator for satisfaction of math requirement
achv_english Indicator for satisfaction of English requirement
achv_hebrew Indicator for satisfaction of Hebrew requirement
lagscore Lagged Bagrut score
qrtl Quartile within distribution of lagscore, calculated by cohort and sex
half Lower or upper half within distribution of lagscore, calculated by cohort and sex

Source

[Angrist Data Archive](#)

References

Angrist, J. D., & Lavy, V. (2009). The effects of high stakes high school achievement awards : Evidence from a randomized trial. *American Economic Review*, *99*(4), 1384-1414. doi:[10.1257/aer.99.4.1384](https://doi.org/10.1257/aer.99.4.1384)

coef_test

Test all regression coefficients in a fitted model

Description

coef_test reports t-tests for each coefficient estimate in a fitted linear regression model, using a sandwich estimator for the standard errors and a small sample correction for the p-value. The small-sample correction is based on a Satterthwaite approximation or a saddlepoint approximation.

Usage

```
coef_test(obj, vcov, test = "Satterthwaite", ...)
```

Arguments

obj Fitted model for which to calculate t-tests.
vcov Variance covariance matrix estimated using vcovCR or a character string specifying which small-sample adjustment should be used to calculate the variance-covariance.

test	Character vector specifying which small-sample corrections to calculate. "z" returns a z test (i.e., using a standard normal reference distribution). "naive-t" returns a t test with $m - 1$ degrees of freedom. "Satterthwaite" returns a Satterthwaite correction. "saddlepoint" returns a saddlepoint correction. Default is "Satterthwaite".
...	Further arguments passed to <code>vcovCR</code> , which are only needed if <code>vcov</code> is a character string.

Value

A data frame containing estimated regression coefficients, standard errors, and test results. For the Satterthwaite approximation, degrees of freedom and a p-value are reported. For the saddlepoint approximation, the saddlepoint and a p-value are reported.

See Also

[vcovCR](#)

dropoutPrevention *Dropout prevention/intervention program effects*

Description

A dataset containing estimated effect sizes, variances, and covariates from a meta-analysis of dropout prevention/intervention program effects, conducted by Wilson et al. (2011). Missing observations were imputed.

Usage

```
dropoutPrevention
```

Format

A data frame with 385 rows and 18 variables:

LOR1 log-odds ratio measuring the intervention effect

varLOR estimated sampling variance of the log-odds ratio

studyID unique identifier for each study

studySample unique identifier for each sample within a study

study_design study design (randomized, matched, or non-randomized and unmatched)

outcome outcome measure for the intervention effect is estimated (school dropout, school enrollment, graduation, graduation or GED receipt)

evaluator_independence degree of evaluator independence (independent, indirect but influential, involved in planning but not delivery, involved in delivery)

implementation_quality level of implementation quality (clear problems, possible problems, no apparent problems)

program_site Program delivery site (community, mixed, school classroom, school but outside of classroom)

attrition Overall attrition (proportion)

group_equivalence pretest group-equivalence log-odds ratio

adjusted adjusted or unadjusted data used to calculate intervention effect

male_pct proportion of the sample that is male

white_pct proportion of the sample that is white

average_age average age of the sample

duration program duration (in weeks)

service_hrs program contact hours per week

big_study indicator for the 32 studies with 3 or more effect sizes

Source

Wilson, S. J., Lipsey, M. W., Tanner-Smith, E., Huang, C. H., & Steinka-Fry, K. T. (2011). Dropout prevention and intervention programs: Effects on school completion and dropout Among school-aged children and youth: A systematic review. *Campbell Systematic Reviews*, 7(8).

References

Wilson, S. J., Lipsey, M. W., Tanner-Smith, E., Huang, C. H., & Steinka-Fry, K. T. (2011). Dropout prevention and intervention programs: Effects on school completion and dropout Among school-aged children and youth: A systematic review. *Campbell Systematic Reviews*, 7(8).

Tipton, E., & Pustejovsky, J. E. (2015). Small-sample adjustments for tests of moderators and model fit using robust variance estimation in meta-regression.

MortalityRates

State-level annual mortality rates by cause among 18-20 year-olds

Description

A dataset containing state-level annual mortality rates for select causes of death, as well as data related to the minimum legal drinking age and alcohol consumption.

Usage

MortalityRates

Format

A data frame with 5508 rows and 12 variables:

year Year of observation

state identifier for state

count Number of deaths

pop Population size

legal Proportion of 18-20 year-old population that is legally allowed to drink

beertaxa Beer taxation rate

beerpercap Beer consumption per capita

winepercap Wine consumption per capita

spiritpercap Spirits consumption per capita

totpercap Total alcohol consumption per capita

mrte Mortality rate per 10,000

cause Cause of death

Source

[Mastering 'Metrics data archive](#)

References

Angrist, J. D., and Pischke, J. S. (2014). *Mastering metrics: the path from cause to effect*. Princeton University Press, 2014.

Carpenter, C., & Dobkin, C. (2011). The minimum legal drinking age and public health. *Journal of Economic Perspectives*, 25_(2), 133-156. doi:[10.1257/jep.25.2.133](http://dx.doi.org/10.1257/jep.25.2.133)

SATcoaching

Randomized experiments on SAT coaching

Description

Effect sizes from randomized experiments on the effects of SAT coaching, reported in Kalaian and Raudenbush (1996)

Usage

SATcoaching

Format

A data frame with 31 rows and 6 variables:

Study Study identifier

nT Sample size in treatment condition

nC Sample size in control condition

T Effect size estimate (Standardized mean difference)

V Variance of effect size estimate

Outcome Factor indicating whether effect size corresponds to outcome on verbal (SATV) or math (SATM) test

References

Kalaian, H. A. & Raudenbush, S. W. (1996). A multivariate mixed linear model for meta-analysis. *Psychological Methods*, 1(3), 227-235. doi:[10.1037/1082-989X.1.3.227](https://doi.org/10.1037/1082-989X.1.3.227)

 vcovCR

Cluster-robust variance-covariance matrix

Description

This is a generic function, with specific methods defined for `lm`, `plm`, `gls`, `lme`, `robu`, `rma.uni`, and `rma.mv` objects.

vcovCR returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates.

Usage

```
vcovCR(obj, cluster, type, target, inverse_var, form, ...)
```

```
## Default S3 method:
```

```
vcovCR(obj, cluster, type, target = NULL,
        inverse_var = FALSE, form = "sandwich", ...)
```

Arguments

<code>obj</code>	Fitted model for which to calculate the variance-covariance matrix
<code>cluster</code>	Expression or vector indicating which observations belong to the same cluster. For some classes, the cluster will be detected automatically if not specified.
<code>type</code>	Character string specifying which small-sample adjustment should be used.
<code>target</code>	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If a vector, the target matrix is assumed to be diagonal. If not specified, vcovCR will attempt to infer a value.

<code>inverse_var</code>	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, <code>vcovCR</code> will attempt to infer a value.
<code>form</code>	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting <code>form = "meat"</code> will return only the meat of the sandwich and setting <code>form = B</code> , where <code>B</code> is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using <code>B</code> as the bread.
<code>...</code>	Additional arguments available for some classes of objects.

Details

`vcovCR` returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates. The matrix has several attributes:

type indicates which small-sample adjustment was used

cluster contains the factor vector that defines independent clusters

bread contains the bread matrix

v_scale constant used in scaling the sandwich estimator

est_mats contains a list of estimating matrices used to calculate the sandwich estimator

adjustments contains a list of adjustment matrices used to calculate the sandwich estimator

target contains the working variance-covariance model used to calculate the adjustment matrices.

This is needed for calculating small-sample corrections for Wald tests.

See Also

[vcovCR.lm](#), [vcovCR.plm](#), [vcovCR.gls](#), [vcovCR.lme](#), [vcovCR.robust](#), [vcovCR.rma.uni](#), [vcovCR.rma.mv](#)

`vcovCR.gls`

Cluster-robust variance-covariance matrix for a gls object.

Description

`vcovCR` returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from a `gls` object.

Usage

```
## S3 method for class 'gls'
vcovCR(obj, cluster, type, target, inverse_var,
       form = "sandwich", ...)
```


Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Optional expression or vector indicating which observations belong to the same cluster. If not specified, will be set to <code>getGroups(obj)</code> .
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If not specified, the target is taken to be the estimated variance-covariance structure of the <code>gls</code> object.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, <code>vcovCR</code> will attempt to infer a value.
form	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting <code>form = "meat"</code> will return only the meat of the sandwich and setting <code>form = B</code> , where <code>B</code> is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using <code>B</code> as the bread.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

`vcovCR.ivreg`

Cluster-robust variance-covariance matrix for an ivreg object.

Description

`vcovCR` returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from an [ivreg](#) object.

Usage

```
## S3 method for class 'ivreg'
vcovCR(obj, cluster, type, target = NULL,
       inverse_var = NULL, form = "sandwich", ...)
```

Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Expression or vector indicating which observations belong to the same cluster. Required for <code>ivreg</code> objects.
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If a vector, the target matrix is assumed to be diagonal. If not specified, the target is taken to be an identity matrix.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, <code>vcovCR</code> will attempt to infer a value.
form	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting <code>form = "meat"</code> will return only the meat of the sandwich and setting <code>form = B</code> , where B is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using B as the bread.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

`vcovCR.lm`

Cluster-robust variance-covariance matrix for an `lm` object.

Description

`vcovCR` returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from an `lm` object.

Usage

```
## S3 method for class 'lm'
vcovCR(obj, cluster, type, target = NULL, inverse_var = NULL,
        form = "sandwich", ...)
```

Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Expression or vector indicating which observations belong to the same cluster. Required for <code>lm</code> objects.
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If a vector, the target matrix is assumed to be diagonal. If not specified, the target is taken to be an identity matrix.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, <code>vcovCR</code> will attempt to infer a value.
form	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting <code>form = "meat"</code> will return only the meat of the sandwich and setting <code>form = B</code> , where <code>B</code> is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using <code>B</code> as the bread.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

`vcovCR.lme`

Cluster-robust variance-covariance matrix for an lme object.

Description

`vcovCR` returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from a [lme](#) object.

Usage

```
## S3 method for class 'lme'
vcovCR(obj, cluster, type, target, inverse_var,
       form = "sandwich", ...)
```

Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Optional expression or vector indicating which observations belong to the same cluster. If not specified, will be set to <code>getGroups(obj)</code> .
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If not specified, the target is taken to be the estimated variance-covariance structure of the <code>lme</code> object.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, <code>vcovCR</code> will attempt to infer a value.
form	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting <code>form = "meat"</code> will return only the meat of the sandwich and setting <code>form = B</code> , where <code>B</code> is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using <code>B</code> as the bread.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

vcovCR.plm

Cluster-robust variance-covariance matrix for a plm object.

Description

`vcovCR` returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from a `plm` object.

Usage

```
## S3 method for class 'plm'
vcovCR(obj, cluster, type, target, inverse_var,
        form = "sandwich", ignore_FE = FALSE, ...)
```

Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Optional character string, expression, or vector indicating which observations belong to the same cluster. For fixed-effect models that include individual effects or time effects (but not both), the cluster will be taken equal to the included fixed effects if not otherwise specified. Clustering on individuals can also be obtained by taking <code>cluster = "individual"</code> and clustering on time periods can be obtained with <code>cluster = "time"</code> . For random-effects models, the cluster will be taken equal to the included random effect identifier if not otherwise specified.
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. By default, the target is taken to be an identity matrix for fixed effect models or the estimated compound-symmetric covariance matrix for random effects models.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, <code>vcovCR</code> will attempt to infer a value.
form	Controls the form of the returned matrix. The default <code>"sandwich"</code> will return the sandwich variance-covariance matrix. Alternately, setting <code>form = "meat"</code> will return only the meat of the sandwich and setting <code>form = B</code> , where <code>B</code> is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using <code>B</code> as the bread.
ignore_FE	Optional logical controlling whether fixed effects are ignored when calculating small-sample adjustments in models where fixed effects are estimated through absorption.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

vcovCR.rma.mv

Cluster-robust variance-covariance matrix for a robu object.

Description

`vcovCR` returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from a `rma.mv` object.

Usage

```
## S3 method for class 'rma.mv'
vcovCR(obj, cluster, type, target, inverse_var,
        form = "sandwich", ...)
```

Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Optional expression or vector indicating which observations belong to the same cluster. If not specified, will be set to the factor in the random-effects structure with the fewest distinct levels. Caveat emptor: the function does not check that the random effects are nested.
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If not specified, the target is taken to be the estimated variance-covariance structure of the rma.mv object.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, vcovCR will attempt to infer a value.
form	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting form = "meat" will return only the meat of the sandwich and setting form = B, where B is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using B as the bread.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

Examples

```
library(metafor)
data(hierdat, package = "robumeta")

mfor_fit <- rma.mv(effectsiz ~ binge + followup + sreport + age,
                 V = var, random = list(~ 1 | esid, ~ 1 | studyid),
                 data = hierdat)

mfor_fit

mfor_CR2 <- vcovCR(mfor_fit, type = "CR2")
mfor_CR2
coef_test(mfor_fit, vcov = mfor_CR2, test = c("Satterthwaite", "saddlepoint"))
```

```
Wald_test(mfor_fit, constraints = c(2,4), vcov = mfor_CR2)
Wald_test(mfor_fit, constraints = 2:5, vcov = mfor_CR2)
```

vcovCR.rma.uni	<i>Cluster-robust variance-covariance matrix for a rma.uni object.</i>
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Description

vcovCR returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from a [rma.uni](#) object.

Usage

```
## S3 method for class 'rma.uni'
vcovCR(obj, cluster, type, target, inverse_var,
        form = "sandwich", ...)
```

Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Expression or vector indicating which observations belong to the same cluster. Required for rma.uni objects.
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If not specified, the target is taken to be diagonal with entries equal to the estimated marginal variance of the effect sizes.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, vcovCR will attempt to infer a value.
form	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting form = "meat" will return only the meat of the sandwich and setting form = B, where B is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using B as the bread.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

Examples

```
library(metafor)
data(corrrdat, package = "robumeta")

mfor_fit <- rma.uni(effectsize ~ males + college + binge,
                  vi = var, data = corrrdat, method = "FE")
mfor_fit
mfor_CR2 <- vcovCR(mfor_fit, type = "CR2", cluster = corrrdat$studyid)
mfor_CR2
coef_test(mfor_fit, vcov = mfor_CR2, test = c("Satterthwaite", "saddlepoint"))
Wald_test(mfor_fit, constraints = 2:4, vcov = mfor_CR2)
```

vcovCR.robust

*Cluster-robust variance-covariance matrix for a robust object.***Description**

vcovCR returns a sandwich estimate of the variance-covariance matrix of a set of regression coefficient estimates from a [robust](#) object.

Usage

```
## S3 method for class 'robust'
vcovCR(obj, cluster, type, target, inverse_var,
       form = "sandwich", ...)
```

Arguments

obj	Fitted model for which to calculate the variance-covariance matrix
cluster	Optional expression or vector indicating which observations belong to the same cluster. If not specified, will be set to the studynum used in fitting the robust object.
type	Character string specifying which small-sample adjustment should be used.
target	Optional matrix or vector describing the working variance-covariance model used to calculate the CR2 and CR4 adjustment matrices. If not specified, the target is taken to be the inverse of the estimated weights used in fitting the robust object.
inverse_var	Optional logical indicating whether the weights used in fitting the model are inverse-variance. If not specified, vcovCR will attempt to infer a value.
form	Controls the form of the returned matrix. The default "sandwich" will return the sandwich variance-covariance matrix. Alternately, setting form = "meat" will return only the meat of the sandwich and setting form = B, where B is a matrix of appropriate dimension, will return the sandwich variance-covariance matrix calculated using B as the bread.
...	Additional arguments available for some classes of objects.

Value

An object of class `c("vcovCR", "clubSandwich")`, which consists of a matrix of the estimated variance of and covariances between the regression coefficient estimates.

See Also

[vcovCR](#)

Examples

```
library(robumeta)
data(hierdat)

robu_fit <- robu(effectsiz ~ binge + followup + sreport + age,
               data = hierdat, studynum = studyid,
               var.eff.size = var, modelweights = "HIER")
robu_fit

robu_CR2 <- vcovCR(robu_fit, type = "CR2")
robu_CR2
coef_test(robu_fit, vcov = robu_CR2, test = c("Satterthwaite", "saddlepoint"))

Wald_test(robu_fit, constraints = c(2,4), vcov = robu_CR2)
Wald_test(robu_fit, constraints = 2:5, vcov = robu_CR2)
```

Wald_test

Test parameter constraints in a fitted linear regression model

Description

`Wald_test` reports Wald-type tests of linear contrasts from a fitted linear regression model, using a sandwich estimator for the variance-covariance matrix and a small sample correction for the p-value. Several different small-sample corrections are available.

Usage

```
Wald_test(obj, constraints, vcov, test = "HTZ", ...)
```

Arguments

<code>obj</code>	Fitted model for which to calculate Wald tests.
<code>constraints</code>	List of one or more constraints to test. See details below.
<code>vcov</code>	Variance covariance matrix estimated using <code>vcovCR</code> or a character string specifying which small-sample adjustment should be used to calculate the variance-covariance.

test	Character vector specifying which small-sample correction(s) to calculate. The following corrections are available: "chi-sq", "Naive-F", "HTA", "HTB", "HTZ", "EDF", "EDT". Default is "HTZ".
...	Further arguments passed to vcovCR , which are only needed if vcov is a character string.

Details

Constraints can be specified as character vectors, integer vectors, logical vectors, or matrices.

Value

A list of test results.

See Also

[vcovCR](#)

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