

Package ‘fwildclusterboot’

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Title Fast Wild Cluster Bootstrap Inference for Linear Regression Models

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Description Implementation of the fast algorithm for wild cluster bootstrap inference developed in Roodman et al (2019, STATA Journal) for linear regression models
<<https://journals.sagepub.com/doi/full/10.1177/1536867X19830877>>, which makes it feasible to quickly calculate bootstrap test statistics based on a large number of bootstrap draws even for large samples - as long as the number of bootstrapping clusters is not too large. Multiway clustering, regression weights, bootstrap weights, fixed effects and subcluster bootstrapping are supported. Further, both restricted (WCR) and unrestricted (WCU) bootstrap are supported. Methods are provided for a variety of fitted models, including 'lm()', 'feols()' (from package 'fixest') and 'felm()' (from package 'lfe').

URL <https://s3alfisc.github.io/fwildclusterboot/>

BugReports <https://github.com/s3alfisc/fwildclusterboot/issues/>

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.onLoad	<i>setting options for nthreads when package is loaded</i>
---------	--

Description

setting options for nthreads when package is loaded

Usage

```
.onLoad(libname, pkgname)
```

Arguments

libname	library name
pkgname	package name

Value

Changes number of threads used.

boottest	<i>Fast wild cluster bootstrap inference</i>
----------	--

Description

boottest is a S3 method that allows for fast wild cluster bootstrap inference for objects of class lm, fixest and felm by implementing the fast wild bootstrap algorithm developed in Roodman et al., 2019.

Usage

```
boottest(object, ...)
```

Arguments

object	An object of type lm, fixest or felm
...	other arguments

Value

An object of class `boottest`

<code>p_val</code>	The bootstrap p-value.
<code>t_stat</code>	The bootstrap t-statistic.
<code>conf_int</code>	The bootstrap confidence interval.
<code>param</code>	The tested parameter.
<code>N</code>	Sample size. Might differ from the regression sample size if the cluster variables contain NA values.
<code>B</code>	Number of Bootstrap Iterations.
<code>clustid</code>	Names of the cluster Variables.
<code>N_G</code>	Dimension of the cluster variables as used in <code>boottest</code> .
<code>sign_level</code>	Significance level used in <code>boottest</code> .
<code>type</code>	Distribution of the bootstrap weights.
<code>p_test_vals</code>	All p-values calculated while calculating the confidence interval.
<code>test_vals</code>	All t-statistics calculated while calculating the confidence interval.
<code>regression</code>	The regression object used in <code>boottest</code> .
<code>call</code>	Function call of <code>boottest</code> .

Confidence Intervals

`boottest` computes confidence intervals by inverting p-values. In practice, the following procedure is used:

- Based on an initial guess for starting values, calculate p-values for 26 equal spaced points between the starting values.
- Out of the 26 calculated p-values, find the two pairs of values x for which the corresponding p-values p_x cross the significance level `sign_level`.
- Feed the two pairs of x into an numerical root finding procedure and solve for the root. `boottest` currently relies on `stats::uniroot` and sets an absolute tolerance of $1e-06$ and stops the procedure after 10 iterations.

Standard Errors

`boottest` does not calculate standard errors.

References

Roodman et al., 2019, "Fast and wild: Bootstrap inference in STATA using `boottest`", The STATA Journal. (<https://journals.sagepub.com/doi/full/10.1177/1536867X19830877>)

Examples

```

library(fwildclusterboot)
data(voters)
lm_fit <- lm(proposition_vote ~ treatment + ideology1 + log_income + Q1_immigration,
             data = voters)
boot1 <- boottest(lm_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = "group_id1")
boot2 <- boottest(lm_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = c("group_id1", "group_id2"))
boot3 <- boottest(lm_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = c("group_id1", "group_id2"),
                 sign_level = 0.2,
                 seed = 8,
                 beta0 = 2)

summary(boot1)
plot(boot1)

```

boottest.felm

Fast wild cluster bootstrap inference for object of class felm

Description

boottest.felm is a S3 method that allows for fast wild cluster bootstrap inference for objects of class felm by implementing the fast wild bootstrap algorithm developed in Roodman et al., 2019.

Usage

```

## S3 method for class 'felm'
boottest(
  object,
  param,
  B,
  clustid,
  bootcluster = "max",
  fe = NULL,
  conf_int = NULL,
  seed = NULL,
  beta0 = 0,
  sign_level = NULL,
  type = "rademacher",
  impose_null = TRUE,
  p_val_type = "two-tailed",

```

```

    tol = 1e-06,
    maxiter = 10,
    na_omit = TRUE,
    nthreads = getBoottest_nthreads(),
    ...
)

```

Arguments

object	An object of class <code>felm</code>
param	Character vector of length one. The name of the regression coefficient for which the hypothesis is to be tested
B	Integer. number of bootstrap iterations
clustid	A vector with the clusters
bootcluster	A character vector. Sets the cluster used in the bootstrap <code>dgp</code> . Chooses the largest cluster by default
fe	A character vector of length one. Fixed effect to be projected out in the bootstrap. Note: if regression weights are used, <code>fe</code> needs to be <code>NULL</code> .
conf_int	A logical vector. If <code>TRUE</code> , <code>boottest</code> computes confidence intervals by p-value inversion. If <code>FALSE</code> , only the p-value is returned.
seed	An integer. Allows the user to set a random seed
beta0	A numeric. Shifts the null hypothesis $H_0: \text{param} = \text{beta0}$ vs $H_1: \text{param} \neq \text{beta0}$
sign_level	A numeric between 0 and 1. E.g. <code>sign_level = 0.05</code> returns 0.95% confidence intervals. By default, <code>sign_level = 0.05</code> .
type	character or function. The character string specifies the type of bootstrap to use: One of "rademacher", "mammen", "norm" and "webb". Alternatively, <code>type</code> can be a function(<code>n</code>) for drawing wild bootstrap factors. "rademacher" by default.
impose_null	Logical. Controls if the null hypothesis is imposed on the bootstrap <code>dgp</code> or not. Null imposed (WCR) by default. If <code>FALSE</code> , the null is not imposed (WCU)
p_val_type	Character vector of length 1. Type of p-value. By default "two-tailed". Other options: "equal-tailed"
tol	Numeric vector of length 1. The desired accuracy (convergence tolerance) for confidence interval inversion. <code>1e-6</code> by default.
maxiter	Integer. Maximum number of iterations for confidence interval inversion. 10 by default.
na_omit	Logical. If <code>TRUE</code> , <code>boottest()</code> omits rows with missing variables that are added to the model via the <code>clustid</code> argument in <code>boottest()</code>
nthreads	The number of threads. Can be: a) an integer lower than, or equal to, the maximum number of threads; b) 0: meaning all available threads will be used; c) a number strictly between 0 and 1 which represents the fraction of all threads to use. The default is to use 1 core.
...	Further arguments passed to or from other methods.

Value

An object of class `boottest`

<code>p_val</code>	The bootstrap p-value.
<code>t_stat</code>	The bootstrap t-statistic.
<code>conf_int</code>	The bootstrap confidence interval.
<code>param</code>	The tested parameter.
<code>N</code>	Sample size. Might differ from the regression sample size if the cluster variables contain NA values.
<code>B</code>	Number of Bootstrap Iterations.
<code>clustid</code>	Names of the cluster Variables.
<code>N_G</code>	Dimension of the cluster variables as used in <code>boottest</code> .
<code>sign_level</code>	Significance level used in <code>boottest</code> .
<code>type</code>	Distribution of the bootstrap weights.
<code>p_test_vals</code>	All p-values calculated while calculating the confidence interval.
<code>test_vals</code>	All t-statistics calculated while calculating the confidence interval.
<code>regression</code>	The regression object used in <code>boottest</code> .
<code>call</code>	Function call of <code>boottest</code> .

Confidence Intervals

`boottest` computes confidence intervals by inverting p-values. In practice, the following procedure is used:

- Based on an initial guess for starting values, calculate p-values for 26 equal spaced points between the starting values.
- Out of the 26 calculated p-values, find the two pairs of values x for which the corresponding p-values p_x cross the significance level `sign_level`.
- Feed the two pairs of x into an numerical root finding procedure and solve for the root. `boottest` currently relies on `stats::uniroot` and sets an absolute tolerance of $1e-06$ and stops the procedure after 10 iterations.

Standard Errors

`boottest` does not calculate standard errors.

References

Roodman et al., 2019, "Fast and wild: Bootstrap inference in STATA using `boottest`", The STATA Journal. (<https://journals.sagepub.com/doi/full/10.1177/1536867X19830877>)

Examples

```

library(fwildclusterboot)
library(lfe)
data(voters)
felm_fit <- felm(proposition_vote ~ treatment + ideology1 + log_income
  | Q1_immigration,
  data = voters)
boot1 <- boottest(felm_fit,
  B = 9999,
  param = "treatment",
  clustid = "group_id1")
boot2 <- boottest(felm_fit,
  B = 9999,
  param = "treatment",
  clustid = c("group_id1", "group_id2"))
boot3 <- boottest(felm_fit,
  B = 9999,
  param = "treatment",
  clustid = c("group_id1", "group_id2"),
  fe = "Q1_immigration")
boot4 <- boottest(felm_fit,
  B = 999,
  param = "treatment",
  clustid = c("group_id1", "group_id2"),
  fe = "Q1_immigration",
  sign_level = 0.2,
  seed = 8,
  beta0 = 2)

summary(boot1)
plot(boot1)

```

boottest.fixest

Fast wild cluster bootstrap inference for object of class fixest

Description

boottest.fixest is a S3 method that allows for fast wild cluster bootstrap inference for objects of class fixest by implementing the fast wild bootstrap algorithm developed in Roodman et al., 2019.

Usage

```

## S3 method for class 'fixest'
boottest(
  object,
  clustid,
  param,
  B,
  bootcluster = "max",
  fe = NULL,

```



```

    sign_level = NULL,
    conf_int = NULL,
    seed = NULL,
    beta0 = 0,
    type = "rademacher",
    impose_null = TRUE,
    p_val_type = "two-tailed",
    tol = 1e-06,
    maxiter = 10,
    na_omit = TRUE,
    nthreads = getBoottest_nthreads(),
    ...
)

```

Arguments

object	An object of class fixest
clustid	A vector with the clusters
param	Character vector of length one. The name of the regression coefficient for which the hypothesis is to be tested
B	Integer. number of bootstrap iterations
bootcluster	A character vector. Sets the cluster used in the bootstrap dgp. Chooses the largest cluster by default
fe	A character vector of length one. Fixed effect to be projected out in the bootstrap. Note: if regression weights are used, fe needs to be NULL.
sign_level	A numeric between 0 and 1. E.g. sign_level = 0.05 returns 0.95% confidence intervals. By default, sign_level = 0.05.
conf_int	A logical vector. If TRUE, boottest computes confidence intervals by p-value inversion. If FALSE, only the p-value is returned.
seed	An integer. Allows the user to set a random seed
beta0	A numeric. Shifts the null hypothesis H0: param = beta0 vs H1: param != beta0
type	character or function. The character string specifies the type of bootstrap to use: One of "rademacher", "mammen", "norm" and "webb". Alternatively, type can be a function(n) for drawing wild bootstrap factors. "rademacher" by default.
impose_null	Logical. Controls if the null hypothesis is imposed on the bootstrap dgp or not. Null imposed (WCR) by default. If FALSE, the null is not imposed (WCU)
p_val_type	Character vector of length 1. Type of p-value. By default "two-tailed". Other options: "equal-tailed"
tol	Numeric vector of length 1. The desired accuracy (convergence tolerance) for confidence interval inversion. 1e-6 by default.
maxiter	Integer. Maximum number of iterations for confidence interval inversion. 10 by default.
na_omit	Logical. If TRUE, boottest() omits rows with missing variables that are added to the model via the clustid argument in boottest()

nthreads	The number of threads. Can be: a) an integer lower than, or equal to, the maximum number of threads; b) 0: meaning all available threads will be used; c) a number strictly between 0 and 1 which represents the fraction of all threads to use. The default is to use 1 core.
...	Further arguments passed to or from other methods.

Value

An object of class `boot test`

p_val	The bootstrap p-value.
t_stat	The bootstrap t-statistic.
conf_int	The bootstrap confidence interval.
param	The tested parameter.
N	Sample size. Might differ from the regression sample size if the cluster variables contain NA values.
B	Number of Bootstrap Iterations.
clustid	Names of the cluster Variables.
N_G	Dimension of the cluster variables as used in boottest.
sign_level	Significance sign_level used in boottest.
type	Distribution of the bootstrap weights.
p_test_vals	All p-values calculated while calculating the confidence interval.
test_vals	All t-statistics calculated while calculating the confidence interval.
regression	The regression object used in boottest.
call	Function call of boottest.

Confidence Intervals

`boottest` computes confidence intervals by inverting p-values. In practice, the following procedure is used:

- Based on an initial guess for starting values, calculate p-values for 26 equal spaced points between the starting values.
- Out of the 26 calculated p-values, find the two pairs of values x for which the corresponding p-values p_x cross the significance `sign_level` `sign_level`.
- Feed the two pairs of x into an numerical root finding procedure and solve for the root. `boottest` currently relies on `stats::uniroot` and sets an absolute tolerance of $1e-06$ and stops the procedure after 10 iterations.

Standard Errors

`boottest` does not calculate standard errors.

References

Roodman et al., 2019, "Fast and wild: Bootstrap inference in STATA using boottest", The STATA Journal. (<https://journals.sagepub.com/doi/full/10.1177/1536867X19830877>)

Examples

```
library(fwildclusterboot)
library(fixest)
data(voters)
feols_fit <- feols(proposition_vote ~ treatment + ideology1 + log_income,
                  fixef = "Q1_immigration",
                  data = voters)
boot1 <- boottest(feols_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = "group_id1")
boot2 <- boottest(feols_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = c("group_id1", "group_id2"))
boot3 <- boottest(feols_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = c("group_id1", "group_id2"),
                 fe = "Q1_immigration")
boot4 <- boottest(feols_fit,
                 B = 10000,
                 param = "treatment",
                 clustid = c("group_id1", "group_id2"),
                 fe = "Q1_immigration",
                 sign_level = 0.2,
                 seed = 8,
                 beta0 = 2)

summary(boot1)
plot(boot1)
```

boottest.lm

Fast wild cluster bootstrap inference for object of class lm

Description

`boottest.lm` is a S3 method that allows for fast wild cluster bootstrap inference for objects of class `lm` by implementing the fast wild bootstrap algorithm developed in Roodman et al., 2019.

Usage

```
## S3 method for class 'lm'
boottest(
  object,
```

```

    clustid,
    param,
    B,
    bootcluster = "max",
    conf_int = NULL,
    seed = NULL,
    beta0 = NULL,
    sign_level = NULL,
    type = "rademacher",
    impose_null = TRUE,
    p_val_type = "two-tailed",
    tol = 1e-06,
    maxiter = 10,
    na_omit = TRUE,
    nthreads = getBoottest_nthreads(),
    ...
)

```

Arguments

object	An object of class lm
clustid	A vector with the clusters
param	Character vector of length one. The name of the regression coefficient for which the hypothesis is to be tested
B	Integer. number of bootstrap iterations
bootcluster	A character vector. Sets the cluster used in the bootstrap dgp. Chooses the largest cluster by default
conf_int	A logical vector. If TRUE, boottest computes confidence intervals by p-value inversion. If FALSE, only the p-value is returned.
seed	An integer. Allows the user to set a random seed
beta0	A numeric. Shifts the null hypothesis H0: param = beta0 vs H1: param != beta0
sign_level	A numeric between 0 and 1. E.g. sign_level = 0.05 returns 0.95% confidence intervals. By default, sign_level = 0.05.
type	character or function. The character string specifies the type of bootstrap to use: One of "rademacher", "mammen", "norm" and "webb". Alternatively, type can be a function(n) for drawing wild bootstrap factors. "rademacher" by default.
impose_null	Logical. Controls if the null hypothesis is imposed on the bootstrap dgp or not. Null imposed (WCR) by default. If FALSE, the null is not imposed (WCU)
p_val_type	Character vector of length 1. Type of p-value. By default "two-tailed". Other options: "equal-tailed"
tol	Numeric vector of length 1. The desired accuracy (convergence tolerance) for confidence interval inversion. 1e-6 by default.
maxiter	Integer. Maximum number of iterations for confidence interval inversion. 10 by default.

na_omit	Logical. If TRUE, boottest() omits rows with missing variables that are added to the model via the clustid argument in boottest()
nthreads	The number of threads. Can be: a) an integer lower than, or equal to, the maximum number of threads; b) 0: meaning all available threads will be used; c) a number strictly between 0 and 1 which represents the fraction of all threads to use. The default is to use 1 core.
...	Further arguments passed to or from other methods.

Value

An object of class boot test

p_val	The bootstrap p-value.
t_stat	The bootstrap t-statistic.
conf_int	The bootstrap confidence interval.
param	The tested parameter.
N	Sample size. Might differ from the regression sample size if the cluster variables contain NA values.
B	Number of Bootstrap Iterations.
clustid	Names of the cluster Variables.
N_G	Dimension of the cluster variables as used in boottest.
sign_level	Significance level used in boottest.
type	Distribution of the bootstrap weights.
p_test_vals	All p-values calculated while calculating the confidence interval.
test_vals	All t-statistics calculated while calculating the confidence interval.
regression	The regression object used in boottest.
call	Function call of boottest.

Confidence Intervals

boottest computes confidence intervals by inverting p-values. In practice, the following procedure is used:

- Based on an initial guess for starting values, calculate p-values for 26 equal spaced points between the starting values.
- Out of the 26 calculated p-values, find the two pairs of values x for which the corresponding p-values p_x cross the significance level `sign_level`.
- Feed the two pairs of x into an numerical root finding procedure and solve for the root. boottest currently relies on `stats::uniroot` and sets an absolute tolerance of $1e-06$ and stops the procedure after 10 iterations.

Standard Errors

boottest does not calculate standard errors.

References

Roodman et al., 2019, "Fast and wild: Bootstrap inference in STATA using boottest", The STATA Journal. (<https://journals.sagepub.com/doi/full/10.1177/1536867X19830877>)

Examples

```
library(fwildclusterboot)
data(voters)
lm_fit <- lm(proposition_vote ~ treatment + ideology1 + log_income + Q1_immigration,
             data = voters)
boot1 <- boottest(lm_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = "group_id1")
boot2 <- boottest(lm_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = c("group_id1", "group_id2"))
boot3 <- boottest(lm_fit,
                 B = 9999,
                 param = "treatment",
                 clustid = c("group_id1", "group_id2"),
                 sign_level = 0.2,
                 seed = 8,
                 beta0 = 2)

summary(boot1)
plot(boot1)
```

boot_algo2

Fast wild cluster bootstrap algorithm

Description

function that implements the fast bootstrap algorithm as described in Roodman et al (2019)

Usage

```
boot_algo2(
  preprocessed_object,
  boot_iter,
  point_estimate,
  impose_null,
  beta0,
  sign_level,
  param,
  seed,
  p_val_type,
  nthreads,
  type
)
```

Arguments

preprocessed_object	A list: output of the preprocess2 function.
boot_iter	number of bootstrap iterations
point_estimate	The point estimate of the test parameter from the regression model.
impose_null	If TRUE, the null is not imposed on the bootstrap distribution. This is what Roodman et al call the "WCU" bootstrap. With impose_null = FALSE, the null is imposed ("WCR").
beta0	Shifts the null hypothesis.
sign_level	The significance level.
param	name of the test parameter.
seed	the random seed. controls draw of bootstrap weights.
p_val_type	type Type of p-value. By default "two-tailed". Other options: "equal-tailed", ">", "<"
nthreads	The number of threads. Can be: a) an integer lower than, or equal to, the maximum number of threads; b) 0: meaning all available threads will be used; c) a number strictly between 0 and 1 which represents the fraction of all threads to use. The default is to use 50\ set permanently the number of threads used within this package using the function ...
type	character or function. The character string specifies the type of bootstrap to use: One of "rademacher", "mammen", "norm" and "webb". Alternatively, type can be a function(n) for drawing wild bootstrap factors. "rademacher" by default.

Value

A list of ...

check_set_nthreads *Simple function that checks that the nber of threads is valid*

Description

Simple function that checks that the nber of threads is valid

Usage

```
check_set_nthreads(nthreads)
```

Arguments

nthreads Integer. Number of threads to be used

Value

Integer. The number of threads to be used.

cpp_get_nb_threads	<i>Get maximum number of threads on hardware for open mp support</i>
--------------------	--

Description

Get maximum number of threads on hardware for open mp support

Usage

```
cpp_get_nb_threads()
```

Value

The maximum number of threads supported.

create_data	<i>Simulate Data</i>
-------------	----------------------

Description

Function simulates data for tests and examples with clustering variables and fixed-effects.

Usage

```
create_data(N, N_G1, icc1, N_G2, icc2, numb_fe1, numb_fe2, seed, weights)
```

Arguments

N	number of observations
N_G1	A scalar. number of clusters for clustering variable 1
icc1	A scalar between 0 and 1. intra-cluster correlation for clustering variable 1
N_G2	A scalar. number of clusters for clustering variable 2
icc2	A scalar between 0 and 1. intra-cluster correlation for clustering variable 2
numb_fe1	A scalar. Number of fixed effect for first factor variable
numb_fe2	A scalar. Number of fixed effect for second factor variable
seed	An integer. Set the random seed
weights	Possible regression weights to be used in estimation

Value

A simulated data. frame with specified numbers of clusters, intra-cluster correlations and dimensionality of fixed effects.

crosstab	<i>optimized collapse way to calculate crosstabs</i>
----------	--

Description

optimized collapse way to calculate crosstabs

Usage

```
crosstab(data, var1, var2)
```

Arguments

data	A matrix to collapse by two dimensions var1 var2
var1	a data.frame containing a single variable
var2	a data.frame containing a single variable

Value

A collapsed matrix of dimension $\text{length}(\text{unique}(\text{var1})) \times \text{length}(\text{unique}(\text{var2}))$. If...

crosstab3	<i>collapse way to calculate crosstabs</i>
-----------	--

Description

collapse way to calculate crosstabs

Usage

```
crosstab3(data, var1, var2)
```

Arguments

data	A matrix to collapse by two dimensions var1 var2
var1	a data.frame containing a single variable
var2	a data.frame containing a single variable

Value

A collapsed matrix of dimension $\text{length}(\text{unique}(\text{var1})) \times \text{length}(\text{unique}(\text{var2}))$. If...

crosstab4 *Function 4 to calculate crosstabs*

Description

Function 4 to calculate crosstabs

Usage

```
crosstab4(data, var1, var2)
```

Arguments

data	A matrix to collapse by two dimensions var1 var2
var1	a data.frame containing a single variable
var2	a data.frame containing a single variable

Value

A collapsed matrix of dimension $\text{length}(\text{unique}(\text{var1})) \times \text{length}(\text{unique}(\text{var2}))$. If...

eigenMapMatMult *Matrix Multiplication via Eigen*

Description

Matrix Multiplication via Eigen

Usage

```
eigenMapMatMult(A, B, nthreads)
```

Arguments

A	A matrix.
B	A matrix.
nthreads	Integer. Number of threads to use for matrix multiplication.

Value

A matrix

eigenMatMult *Matrix Multiplication via Eigen*

Description

Matrix Multiplication via Eigen

Usage

```
eigenMatMult(A, B, nthreads)
```

Arguments

A	A matrix.
B	A matrix.
nthreads	Integer. Number of threads to use for matrix multiplication.

Value

A matrix

getBoottest_nthreads *get the number of threads for use with open mp*

Description

get the number of threads for use with open mp

Usage

```
getBoottest_nthreads()
```

Value

The number of threads currently used by boottest as set in options

glance.boottest	<i>S3 method to glance at objects of class boottest</i>
-----------------	---

Description

S3 method to glance at objects of class boottest

Usage

```
## S3 method for class 'boottest'
glance(x, ...)
```

Arguments

x	object of type boottest
...	Further arguments passed to or from other methods.

Value

A single row summary "glance" of an object of type boottest - lists characteristics of the input regression model

invert_p_val2	<i>Calculation of Confidence Sets</i>
---------------	---------------------------------------

Description

Inverts the bootstrap p-value and calculates confidence sets

Usage

```
invert_p_val2(
  object,
  boot_iter,
  point_estimate,
  se_guess,
  clustid,
  sign_level,
  vcov_sign,
  impose_null,
  p_val_type,
  tol,
  maxiter
)
```

Arguments

object	A object of type boottest
boot_iter	An integer. Number of bootstrap iterations
point_estimate	A scalar. Point estimate of the coefficient of interest from the regression model
se_guess	A scalar vector of dimension 2. A guess of the standard error that initiates the p-value inversion.
clustid	A vector with the clusters
sign_level	A numeric between 0 and 1. Sets to confidence level: sign_level = 0.05 returns 0.95% confidence intervals
vcov_sign	Controls addition / subtraction of individual covariance matrices for multiway clustering
impose_null	Logical. Controls if the null hypothesis is imposed on the bootstrap dgp or not. Null imposed - WCR - by default. If FALSE, unrestricted WCU
p_val_type	type Type of p-value. By default "two-tailed". Other options: "equal-tailed", ">", "<"
tol	the desired accuracy (convergence tolerance) for confidence interval inversion. 1e-6 by default.
maxiter	maximum number of iterations for confidence interval inversion. 10 by default.

Value

A list containing the calculated confidence interval, the t-statistics and corresponding p-values used in the grid search.

plot.boottest	<i>Plot the bootstrap distribution of t-statistics</i>
---------------	--

Description

Plot the bootstrap distribution of t-statistics

Usage

```
## S3 method for class 'boottest'
plot(x, ...)
```

Arguments

x	An object of type boottest
...	Further arguments passed to or from other methods.

Value

A plot of bootstrap t-statistics under different null hypotheses

preprocess2	<i>function that pre-processes regression objects of type lm, fixest and feols</i>
-------------	--

Description

function that pre-processes regression objects of type lm, fixest and feols

Usage

```
preprocess2(object, cluster, fe, param, bootcluster, na_omit)
```

Arguments

object	An object of class lm, fixest or felm
cluster	A vector with the names of the clusters
fe	A character scalar - fixed effect to be projected out, or NULL
param	The univariate coefficients for which a hypothesis is to be tested
bootcluster	The bootstrap sampling cluster.
na_omit	Logical. If TRUE, boottest() omits rows with missing variables that are added to the model via the cluster argument in boottest()

Value

List containing preprocessed data for boottest estimation

p_val_null2	<i>Calculate p-values based on A, B, CC, CD, DD and other inputs</i>
-------------	--

Description

Calculate p-values based on A, B, CC, CD, DD and other inputs

Usage

```
p_val_null2(
  beta0,
  A,
  B,
  CC,
  CD,
  DD,
  clustid,
  boot_iter,
```

```

    small_sample_correction,
    impose_null,
    point_estimate,
    p_val_type
  )

```

Arguments

beta0	Scalar. Shifts the null hypothesis.
A	A list.
B	A list.
CC	A list.
CD	A list.
DD	A list.
clustid	A data.frame containing the cluster variables.
boot_iter	An integer. Number of bootstrap iterations.
small_sample_correction	A vector of the dimension of ncol(clustid)
impose_null	If TRUE, no null hypothesis if imposed on the bootstrap
point_estimate	The point estimate of the test parameter from the regression model.
p_val_type	type Type of p-value. By default "two-tailed". Other options: "equal-tailed", ">", "<"

Value

A list containing the bootstrapped p-value, the bootstrapped t-statistics, and the number of invalid test statistics.

setBoottest_nthreads *Set the number of threads for use with open mp via options By default, only one thread is used*

Description

Set the number of threads for use with open mp via options By default, only one thread is used

Usage

```
setBoottest_nthreads(nthreads)
```

Arguments

nthreads	Integer. Number of threads to be used
----------	---------------------------------------

Value

No return value

summary.boottest	<i>S3 method to summarize objects of class boottest</i>
------------------	---

Description

S3 method to summarize objects of class boottest

Usage

```
## S3 method for class 'boottest'
summary(object, digits = 3, ...)
```

Arguments

object	object of type boottest
digits	rounding of output. 3 by default
...	Further arguments passed to or from other methods.

Value

Returns result summaries for objects of type boottest

tidy.boottest	<i>S3 method to summarize objects of class boottest into tidy data.frame</i>
---------------	--

Description

S3 method to summarize objects of class boottest into tidy data.frame

Usage

```
## S3 method for class 'boottest'
tidy(object, ...)
```

Arguments

object	object of type boottest
...	Further arguments passed to or from other methods.

Value

A tidy data.frame with estimation results for objects of type boottest

voters	<i>Random example data set</i>
--------	--------------------------------

Description

Random example data set

Usage

```
data(voters)
```

Format

An object of class `data.frame` with 300 rows and 13 columns.

Examples

```
data(voters)
```

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