Package 'hr'

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Type Package

Title Bootstrap Model Average Unit Root Test

Version 1.0-1

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Imports boot, fUnitRoots, np, quadprog

Suggests CADFtest, tseries

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Description This package implements the Hansen-Racine nonparametric bootstrap model average unit root test.

License GPL-2

URL https://github.com/JeffreyRacine/R-Package-hr

BugReports https://github.com/JeffreyRacine/R-Package-hr/issues

NeedsCompilation no

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`hr-package` *Bootstrap Model Average Unit Root Test*

Description

This package implements the Hansen-Racine nonparametric bootstrap model average unit root test.

Details

The DESCRIPTION file:

Package:	hr
Type:	Package
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Version:	1.0-1
Date:	2017-05-12
Imports:	boot, fUnitRoots, np, quadprog
Suggests:	CADFtest, tseries
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hr.test                 Hansen-Racine Bootstrap Model Averaged Unit
                        Root Test

vignette("bmmaur", package = "hr")
```

Author(s)

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References

Racine (2017), "Bootstrap Mallows Model Averaging Unit Root Inference," Technical Report.

See Also

pp.test

Examples

```
## Generate a series with a unit root, MA errors

set.seed(42)
T <- 100
x <- arima.sim(list(order=c(0,1,1),ma=-0.8),n=T)

## Compute the test

hr.test(x,B=99)
```

```
## The Phillips-Perron test rejects 100% of the time for this DGP

suppressPackageStartupMessages(library("tseries"))

pp.test(x)

## The ADF test with BIC model selection incorrectly rejects the null a large
## fraction of the time for this DGP

suppressPackageStartupMessages(library("CADFtest"))

CADFtest(x,max.lag.y=round(12*(T/100)^0.25),criterion="BIC",type="drift")
```

`hr.test` *Hansen-Racine Bootstrap Model Averaged Unit Root Test*

Description

Computes a nonparametric bootstrap model average test for the null hypothesis that x has a unit root against stationary, explosive, or both alternatives.

Usage

```
hr.test(x = NULL,
        adf.type = c("c","ct","nc","all"),
        alpha = 0.05,
        alternative = c("stationary","explosive","both"),
        B = 399,
        boot.method = c("geom","fixed","iid"),
        df.type = c("nc","c","ct","nccct","ncc","nct","cct","none"),
        group.start = 4,
        group.by = 4,
        lag.vec = NULL,
        method = c("jma","mma"),
        quantile.vec = c(0.005,0.01,0.025,0.05,0.95,0.975,0.99,0.995),
        random.seed = 42,
        S = 12,
        verbose = TRUE)
```

Arguments

`x`	a univariate time series (`numeric` will be converted automatically)
`adf.type`	whether to include in the estimating equations Augmented Dickey-Fuller (ADF) models with no constant (nc), constant (c) or constant and trend (ct), or to include all three
`alpha`	size of the test
`alternative`	alternative hypothesis (null hypothesis is that x has a unit root)

B	number of bootstrap replications
boot.method	whether to use sim="geom" or sim="fixed" in the call to tsboot (sim="iid" generates a naive bootstrap)
df.type	whether to include in the estimating equations a Dickey-Fuller (DF) model with no constant (nc), constant (c), or constant and a trend (ct), two DF models with no constant and constant (ncc) or no constant and constant and trend (nct) or constant and constant and trend (cct), or three DF models with no constant and constant and constant and trend (nccct), or to include no DF models (none)
group.start	maximum lag for first starting group for Hansen's (2014) grouping of covariates
group.by	group size (subsequent to group.start) for Hansen's (2014) grouping of covariates
lag.vec	optional vector of lags for the ADF estimating equations (default uses a modification of Schwert's (1989) ad hoc rule)
method	whether to use Hansen's (2007) Mallows model averaging criterion or Hansen and Racine's (2012) jackknife model averaging criterion
quantile.vec	vector of probabilities for the null quantile values returned
random.seed	random seed for the procedure
S	the constant in Schwert's (1989) ad-hoc formula for maximum lag selection
verbose	whether or not to display progress

Details

Typical usages are

```
hr.test(x)
hr.test(x,B=999)
hr.test(x,lag.vec=2:8)
hr.test(x,S=8)
hr.test(x,method="mma")
```

The default involves taking a set of DF and ADF estimating equations (ADF contain k > 0 lags of the differenced series, DF contain 0 lags) with covariates i) the first lag of x (DF, (nc)) an ii) a constant, the first lag of x and 1 through 3, 7, and 11 lags of the differenced x (ADF, (c)). The convention to consider blocks of at least 4 regressors is adopted (Hansen (2014)). Next, take the unit root test statistics from each of the estimating equations (in each estimating equation the first difference of x is regressed on the covariates and the test statistic is the t-statistic associated with the coefficient on the first lag of x). Finally, average these statistics using either a Mallows criterion (Hansen (2007)) or a jackknife criterion (Hansen and Racine (2012)). By default, Schwert's (1989) ad-hoc rule is used to determine the maximum lag k to be used (round(S*(T/100)^0.25)) where T is the length of x).

The null distribution of the model averaged test statistic is constructed using a model-free nonparametric bootstrap applied to the first difference of x similar to that outlined in Swensen (2003). A stationary geometric bootstrap (Politis and Romano (1994)) with automatic expected block length selection (Patton, Politis and White (2009)) is employed, and the null is imposed by taking the cumulative sum of the bootstrap values initialized to the first value of x; see vignette("bmaur", package = "hr") for further details.

Simulations reveal that the test's size and power is quite balanced regardless of how large the number of estimating equations may be, more so than those for its peers, particularly in cases known to confound existing tests. The test displays the lowest size distortions in such cases among the range of tests considered (Phillips-Perron, Ng-Perron with modified AIC model selection, ADF with BIC model selection). Of these three peers, the Ng-Perron test exhibits the smallest size distortions in cases known to confound existing tests. Not only does our model average test have the lowest size distortions in such cases among all tests considered, but it also exhibits higher power than Ng-Perron's approach. The Phillips-Perron and ADF tests can fail to distinguish between stationary and non-stationary cases even for large samples of data (see the example below) and therefore cannot be recommended for general application. To the best of our knowledge, this is the first such unit root test to be proposed that is based on model averaging.

We use the function `b.star` from the **np** package for the automatic dependent bootstrap procedure, `solve.QP` from the **quadprog** package to solve the quadratic program for the model average weights), `tsboot` from the **boot** package to generate the stationary geometric bootstrap resample, and the `adfTest` function from the **fUnitRoots** package to generate the statistics that are averaged.

Note that the default tests for the presence of a unit root (point null) version a stationary alternative. Rejection of the null implies stationarity, however failure to reject could arise when the series contains a unit root or is explosive. This is the reason why two critical values are returned no matter what the alternative (for the one-sided alternatives they are the alpha tail critical values instead of the alpha/2 tail ones, so you can determine whether failure to reject is an indication of a unit root or an explosive series).

Value

A list with class "hrtest" containing the following components:

`adf.lags`	vector of lags used for the augmented models
`alpha`	size of test
`decision`	outcome of test
`e.block.length`	expected block length for the stationary geometric bootstrap returned by `b.star`
`ma.weights`	vector of model average weights
`quantiles`	vector of nonparametric null quantiles
`reject`	1 if reject, 0 otherwise
`tau.boot`	sorted vector of bootstrapped test statistics generated under the null of a unit root
`tau.low`	lower critical value
`tau.up`	upper critical value
`tau`	model averaged test statistic

Note

This package is in beta status until further notice - proceed accordingly.

Author(s)

Jeffrey S. Racine

References

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Swensen, A. R. (2003), "Bootstrapping unit root tests for integrated processes," Journal of Time Series Analysis 24(1), 99-126.

See Also

pp.test, PP.test, adf.test, adfTest, unitrootTest, ur.df, CADFtest

Examples

```
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