

Package ‘CADFtest’

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Title Hansen’s Covariate-Augmented Dickey-Fuller (CADF) Test

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Author Claudio Lupi

Maintainer Claudio Lupi <lupi@unimol.it>

Depends dynlm, sandwich, tseries, urca

Suggests fUnitRoots

Description This package performs Hansen’s (1995) Covariate-Augmented Dickey-Fuller (CADF) test. The only required argument is `y`, the univariate time series to be tested. If no stationary covariate `X` is passed to the procedure, then an ordinary ADF test is performed. The p-values of the test are computed using a procedure proposed in Costantini, Lupi and Popp (2007), illustrated in Lupi (2009).

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CADFpvalues	<i>p-values of the CADF test.</i>
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Description

The asymptotic p-values of the Hansen's (1995) Covariate-Augmented Dickey Fuller (CADF) test for a unit root are computed using the approach outlined in Costantini et al. (2007).

Usage

```
CADFpvalues(t0, rho2 = 0.5, type=c("trend", "drift", "none"))
```

Arguments

t0	the value of the test statistic;
rho2	the estimated value of the long-run correlation;
type	defines the deterministic kernel used in the test. It accepts the values used in package <code>urca</code> . It specifies if the underlying model must be with linear trend ("trend", the default), with constant ("drift") or without constant ("none").

Value

`p.value`, a scalar containing the estimated asymptotic p-value of the test.

Author(s)

Claudio Lupi

References

Hansen BE (1995). Rethinking the Univariate Approach to Unit Root Testing: Using Covariates to Increase Power, *Econometric Theory*, **11**(5), 1148–1171.

Costantini M, Lupi C, Popp S (2007), A Panel-CADF Test for Unit Roots, University of Molise, *Economics & Statistics Discussion Paper 39/07*. <http://econpapers.repec.org/paper/molecsdps/esdp07039.htm>

Examples

```
CADFpvalues(t0=-1.7, rho2=0.20, type="trend")
```

Description

This function is an interface to `CADFtest.default` that computes the CADF unit root test proposed in Hansen (1995). The asymptotic p-values of the test are also computed along the lines proposed in Costantini et al. (2007). Automatic model selection is allowed. A full description and some applications can be found in Lupi (2009).

Usage

```
CADFtest(model, X=NULL, type=c("trend", "drift", "none"),
         data=list(), max.lag.y=1, min.lag.X=0, max.lag.X=0,
         dname=NULL, criterion=c("none", "BIC", "AIC", "HQC",
                                "MAIC"), ...)
```

Arguments

<code>model</code>	a formula of the kind $y \sim x_1 + x_2$ containing the variable y to be tested and the stationary covariate(s) to be used in the test. If the model is specified as $y \sim 1$, then an ordinary ADF is carried out. Note that the specification $y \sim .$ here does not imply a model with all the disposable regressors, but rather a model with no stationary covariate (which corresponds to an ADF test). This is because the stationary covariates have to be explicitly indicated (they are usually one or two). An ordinary ADF is performed also if <code>model=y</code> is specified, where y is a vector or a time series. It should be noted that <code>model</code> is not the actual model, but rather a representation that is used to simplify variable specification. The covariates are assumed to be stationary.
<code>X</code>	if <code>model=y</code> , a matrix or a vector time series of stationary covariates X can be passed directly, instead of using the <code>formula</code> expression. However, the <code>formula</code> expression should in general be preferred.
<code>type</code>	defines the deterministic kernel used in the test. It accepts the values used in package <code>urca</code> . It specifies if the underlying model must be with linear trend ("trend", the default), with constant ("drift") or without constant ("none").
<code>data</code>	data to be used (optional). This argument is effective only when <code>model</code> is passed as a formula.
<code>max.lag.y</code>	maximum number of lags allowed for the lagged differences of the variable to be tested.
<code>min.lag.X</code>	if negative it is maximum lead allowed for the covariates. If zero, it is the minimum lag allowed for the covariates.
<code>max.lag.X</code>	maximum lag allowed for the covariates.
<code>dname</code>	NULL or character. It can be used to give a special name to the model. If the NULL default is accepted and the model is specified using a formula notation, then <code>dname</code> is computed according to the used formula.

<code>criterion</code>	it can be either "none" (the default), "BIC", "AIC", "HQC" or "MAIC". If <code>criterion="none"</code> , no automatic model selection is performed. Otherwise, automatic model selection is performed using the specified criterion. In this case, the max and min orders serve as upper and lower bounds in the model selection.
<code>...</code>	Extra arguments that can be set to use special kernels, prewhitening, etc. in the estimation of ρ^2 . A Quadratic kernel with a VAR(1) prewhitening is the default choice. To set these extra arguments to different values, see <code>kernHAC</code> in package <code>sandwich</code> (Zeileis, 2004, 2006). If Hansen's results have to be duplicated, then <code>kernel="Parzen"</code> and <code>prewhite=FALSE</code> must be specified.

Value

The function returns an object of class `c("CADFtest", "htest")` containing:

<code>statistic</code>	the t test statistic.
<code>parameter</code>	the estimated nuisance parameter ρ^2 (see Hansen, 1995, p. 1150).
<code>method</code>	the test performed: it can be either ADF or CADF.
<code>p.value</code>	the p-value of the test.
<code>data.name</code>	the data name.
<code>max.lag.y</code>	the maximum lag of the differences of the dependent variable.
<code>min.lag.X</code>	the maximum lead of the stationary covariate(s).
<code>max.lag.X</code>	the maximum lag of the stationary covariate(s).
<code>AIC</code>	the value of the AIC for the selected model.
<code>BIC</code>	the value of the BIC for the selected model.
<code>HQC</code>	the value of the HQC for the selected model.
<code>MAIC</code>	the value of the MAIC for the selected model.
<code>est.model</code>	the estimated model.
<code>estimate</code>	the estimated value of the parameter of the lagged dependent variable.
<code>null.value</code>	the value of the parameter of the lagged dependent variable under the null.
<code>alternative</code>	the alternative hypothesis.
<code>call</code>	the call to the function.
<code>type</code>	the deterministic kernel used.

Note

If p-values are used, please cite Costantini et al. (2007).

Author(s)

Claudio Lupi

References

- Costantini M, Lupi C, Popp S (2007). A Panel-CADF Test for Unit Roots, University of Molise, *Economics & Statistics Discussion Paper 39/07*. <http://econpapers.repec.org/paper/molecsdps/esdp07039.htm>
- Hansen BE (1995). Rethinking the Univariate Approach to Unit Root Testing: Using Covariates to Increase Power, *Econometric Theory*, **11**(5), 1148–1171.
- Lupi C (2009). Unit Root CADF Testing with R, *Journal of Statistical Software*, **32**(2), 1–19. <http://www.jstatsoft.org/v32/i02/>
- Zeileis A (2004). Econometric Computing with HC and HAC Covariance Matrix Estimators, *Journal of Statistical Software*, **11**(10), 1–17. <http://www.jstatsoft.org/v11/i10/>
- Zeileis A (2006). Object-Oriented Computation of Sandwich Estimators, *Journal of Statistical Software*, **16**(9), 1–16. <http://www.jstatsoft.org/v16/i09/>.

See Also

fUnitRoots, urca

Examples

```
##---- ADF test on extended Nelson-Plosser data ----
##-- Data taken from package urca
data(npext, package="urca")
ADFT <- CADFtest(npext$gnpperca, max.lag.y=3, type="trend")

##---- CADF test on extended Nelson-Plosser data ----
data(npext, package="urca")
npext$unemrate <- exp(npext$unemploy)      # compute unemployment rate
L <- ts(npext, start=1860)                 # time series of levels
D <- diff(L)                               # time series of diffs
S <- window(ts.intersect(L,D), start=1909) # select same sample as Hansen's
CADFT <- CADFtest(L.gnpperca~D.unemrate, data=S, max.lag.y=3,
  kernel="Parzen", prewhite=FALSE)
```

coeffs_ct

Tables of coefficients to compute p-values as estimated by Costantini et al. (2007)

Description

These tables contain the response surface coefficients needed to compute the p-value of Hansen's CADF test (see Costantini et al., 2007; Lupi, 2009). `coeffs_ct`, `coeffs_c`, `coeffs_nc` are the relevant tables for the constant plus trend, constant, and no constant case, respectively.

Usage

```
data("coeffs_ct")
```

Format

The tables are saved as binary data `.rda` objects. They are (1005×5) matrices, where the first column represents probabilities and the following four columns are β_0, \dots, β_3 in eqn. (13) in Costantini et al. (2007) (see also Lupi, 2009).

Note

If these tables are used, please cite Costantini et al. (2007).

Author(s)

Claudio Lupi

Source

Costantini et al. (2007).

References

Costantini M, Lupi C, Popp S (2007), A Panel-CADF Test for Unit Roots, University of Molise, *Economics & Statistics Discussion Paper* 39/07. <http://econpapers.repec.org/paper/molecsdps/esdp07039.htm>.

Lupi C (2009). Unit Root CADF Testing with R, *Journal of Statistical Software*, **32**(2), 1–19. <http://www.jstatsoft.org/v32/i02/>

plot.CADFtest

Function to plot CADFtest objects

Description

This function conveniently plots the residuals of the Covariate Augmented Dickey-Fuller or the standard Augmented Dickey-Fuller regression carried out in `CADFtest`.

Usage

```
## S3 method for class 'CADFtest':
plot(x, plots=(1:4), ...)
```

Arguments

<code>x</code>	an object belonging to the class <code>CADFtest</code> .
<code>plots</code>	the plots to be produced (all the four plots by default): 1: standardized residuals plot; 2: density of the residuals, with an indication of the p-value of the Jarque-Bera test for normality; 3: ACF of the residuals; 4: partial ACF of the residuals.
<code>...</code>	currently not used.

Author(s)

Claudio Lupi

Examples

```
data(npext, package="urca")
ADFt <- CADFtest(npext$realgnp, type="trend")
plot(ADFt, plots=c(3,4))
```

residuals.CADFtest *Function to extract the residuals from CADFtest objects*

Description

This function applies the `residuals()` method to an object of class `CADFtest`.

Usage

```
## S3 method for class 'CADFtest':
residuals(object, ...)
```

Arguments

`object` an object belonging to the class `CADFtest`.
`...` currently not used.

Author(s)

Claudio Lupi

Examples

```
data(npext, package="urca")
ADFt <- CADFtest(npext$realgnp, type="trend")
residuals(ADFt)
```

summary.CADFtest *Function to print a summary of CADFtest objects*

Description

This function conveniently prints the detailed results of the Covariate-Augmented Dickey Fuller test carried out in `CADFtest`.

Usage

```
## S3 method for class 'CADFtest':  
summary(object, ...)
```

Arguments

`object` an object belonging to the class `CADFtest`.
`...` currently not used.

Value

The function returns an object of class `CADFtestsummary` containing the main results of the test.

`test.summary` a matrix, containing the t-test statistic, the estimated value of ρ^2 , the p-value of the test, the max lag used for the differenced dependent variable, the max lag of the stationary covariate, the max lead of the stationary covariate. When a standard ADF test is performed, only the t-test statistic, the p-value and the max lag of the differenced dependent variable are reported.

`model.summary` the summary of the test model, in the usual form. However, note that the p-value of the lagged dependent is computed under the null of a unit root. Furthermore, differently from the common practice, the F-statistic refers to the joint significance of the stationary regressors. If no stationary regressors are used (no lagged differences of the dependent, no stationary covariates) then the F-statistic is not computed and a NA value is returned.

Author(s)

Claudio Lupi

Examples

```
data(npext, package="urca")  
ADFt <- CADFtest(npext$realgnp, type="trend")  
summary(ADFt)
```

update.CADFtest *Function to update the formula of CADFtest objects*

Description

This function updates the formula and/or the other arguments of CADFtest object and re-run the test using the updated arguments. It can be useful if one wants to see the effect of adding/removing stationary covariates or the effect of changing lags, kernel, etc. If covariates have to be added/removed, update() works only if model is passed as a formula.

Usage

```
## S3 method for class 'CADFtest':
update(object, change, ...)
```

Arguments

object	an object belonging to the class CADFtest.
change	list of character describing the changes to be applied to the existing model.
...	currently not used.

Value

The function re-run the test and returns an object of class CADFtest. See CADFtest().

Author(s)

Claudio Lupi

Examples

```
data(npext, package="urca")
npext$unemrate <- exp(npext$unemploy)      # compute unemployment rate
L <- ts(npext, start=1860)                  # time series of levels
D <- diff(L)                                # time series of diffs
S <- window(ts.intersect(L,D), start=1909) # select same sample as Hansen's
CADFt <- CADFtest(L.gnpperca~D.unemrate, data=S, max.lag.y=3,
  kernel="Parzen", prewhite=FALSE)
CADFt.2 <- update(CADFt, change=list("+ D.indprod", "max.lag.X=3",
  "criterion='BIC'"))
```

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