Package ‘uroot’

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Title Unit Root Tests for Seasonal Time Series

Depends R (>= 3.0.0), stats

URL https://geobosh.github.io/uroot/

BugReports https://github.com/GeoBosh/uroot/issues

Encoding UTF-8

Description Seasonal unit roots and seasonal stability tests.
P-values based on response surface regressions are available for both tests.
P-values based on bootstrap are available for seasonal unit root tests.

LazyData yes

LazyDataCompression xz

License GPL-2

NeedsCompilation no

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R topics documented:

uroot-package *Unit Root Tests for Seasonal Time Series*

Description

Canova and Hansen (CH) test for seasonal stability and Hylleberg, Engle, Granger and Yoo (HEGY) test for seasonal unit roots.

Details

Version >= 2.0.0 is a revival of the former package **uroot**. Some of the functions provided in the original versions have been coded from the scratch.

The current version provides the Canova and Hansen (CH) test for seasonal stability and the Hylleberg, Engle, Granger and Yoo (HEGY) test for seasonal unit roots.

New features:

The original functions have been enhanced with the following new features: 1) the tests are now applicable to series of any seasonal periodicity (not only quarterly and monthly data), 2) p-values based on response surface regressions are available, 3) bootstrapped p-values are available for the HEGY test statistics.

Old features not currently supported:

Some of the utilities available in the initial versions of the package are not available now: graphics for seasonal series, graphical user interface, bootstrap versions of the statistics, ADF test and KPSS test. Some of these utilities are available in other packages and some will probably be incorporated in future versions of this package.

System requirements:

Windows systems: GPU parallelization of the bootstrap is not currently operational on windows systems.

Unix systems: GPU parallelization of the bootstrap requires a CUDA capable GPU with compute capability >= 3.0.

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References

Burridge, P. and Taylor, R. (2004) "Bootstrapping the HEGY seasonal unit root tests." *Journal of Econometrics* **123**(1), pp. 67-87. DOI: doi:10.1016/j.jeconom.2003.10.029.

Canova, F. and Hansen, Bruce E. (1995) "Are seasonal patterns constant over time? A test for seasonal stability". *Journal of Business & Economic Statistics*, **13**(3), pp. 237-252. DOI: doi:10.1080/07350015.1995.10524598.

Díaz-Emparanza, I. (2014) "Numerical distribution functions for seasonal unit root tests"- *Computational Statistics and Data Analysis*, **76**, pp. 237-247. DOI: doi:10.1016/j.csda.2013.03.006.

Díaz-Emparanza, I. and Moral, M. P. (2013). *Seasonal stability tests in gretl. An application to international tourism data*. Working paper: Biltoki D.T. 2013.03.

Hylleberg, S., Engle, R., Granger, C. and Yoo, B. (1990) "Seasonal integration and cointegration". *Journal of Econometrics* **44**(1), pp. 215-238. DOI: doi:10.1016/03044076(90)90080D.

`bgt.data` *BGT-data Sample Data Set*

Description

UK macroeconomic data. Sample data set employed in Burridge, Gjorstrup and Taylor (2004).

Usage

```
bgt.data
```

Format

A list containing time series objects.

References

Burridge, P., Gjorstrup, F. and Taylor, R. (2004) *Robust Inference on Seasonal Unit Roots via a Bootstrap Applied to OECD Macroeconomic Series*. Department of Economics, City University London. Working Paper 04/08. URL: `https://ideas.repec.org/p/cty/dpaper/04-08.html`.

`ch.data` *CH-data Sample Data Set*

Description

U.S. post World War II macroeconomic time series. The data set is described and employed in Canova and Hansen (JBES, 1995, Section 5.1).

Usage

```
ch.data
```

Format

A list containing time series objects.

Source

`https://www.ssc.wisc.edu/~bhansen/progs/jbes_95.html` ch.rs.pvalue *P-values for the CH test statistic*

Description

Compute p-values for the Canova and Hansen (CH) test statistic based on the response surface regressions approach.

Usage

```
ch.rs.pvalue(x, type, lag1, S, n, nobsreg, VMdf)
```

Arguments

x	a numeric. The value of the CH statistic.
type	a string specifying the formulation of the test, "dummy" for seasonal dummies or "trigonometric" for seasonal cycles.
lag1	logical indicating whether a first order lag of was included in the regression model.
S	numeric, the periodicity of the data.
n	numeric, the number of observations.
nobsreg	an integer indicating the number of points employed in the response surface regression.
VMdf	numeric, the degrees of freedom of the Von Mises distribution.

Details

Ported from Gretl code provided by Díaz-Emparanza and Moral (2013).

For type="dummy", the p-value for the joint test statistic is not available.

This function is mainly intended to be used internally by ch.test.

Value

A numeric giving the calculated p-value.

References

Díaz-Emparanza, I. and Moral, M. P. (2013) *Seasonal Stability Tests in gretl. An Application to International Tourism Data*. Working paper: Biltoki D.T. 2013.03. URL: https://addi.ehu.es/handle/10810/10577. Gretl code: https://www.ehu.eus/ignacio.diaz-emparanza/packages/Canova_Hansen.gfn (seems unavailable, so not linked)

See Also

ch.test.

ch.test *Canova and Hansen Test for Seasonal Stability*

Description

Canova and Hansen (CH) test statistic for the null hypothesis of a stable seasonal pattern.

Usage

```
ch.test(x, type = c("dummy", "trigonometric"), lag1 = FALSE, NW.order = NULL,
  sid = NULL, xreg = NULL, pvalue = c("RS", "raw"), rs.nobsreg = 13)
```

Arguments

x	a univariate seasonal time series.
type	a character string specifying the formulation of the test, "dummy" for seasonal dummies or "trigonometric" for seasonal cycles.
lag1	logical, if TRUE a first order lag of the time series x is included in the regression model. The default is FALSE.
NW.order	an integer, the lag truncation parameter to be used in the Newey and West covariance matrix.
sid	an optional numeric vector, the target seasonal dummies or cycles to be tested. By default all the individual and joint test statistics are returned.
xreg	an optional vector or matrix of external regressors with the same length or number of rows as the length of the input time series x.
pvalue	a character specifying the method employed to compute p-values: "RS", the default, interpolation based on response surface regressions; "raw", interpolation in the tabulated values provided in the reference paper for the Von Mises distribution.
rs.nobsreg	an integer indicating the number of points employed in the response surface regression (only for pvalue = "RS").

Details

The seasons or seasonal cycles to be tested can be chosen through an indicator variable defined in the argument sid. By default, all the t-statistics related to each individual dummy or cycle and the joint F-statistic

are returned.

If type = "dummy", the index of the target seasons can be specified in sid. For example, in a quarterly series: sid=c(2) returns the test statistic to the stability of the second quarter; sid=c(1,3) returns the joint test statistic for the first and third quarters; sid=c(1,2,3,4) returns the joint test statistic for the null of seasonal stability at all seasons.

If type = "trigonometric", the indicator vector sid must be of length floor(frequency(x)/2) and will consist of ones and zeros. Each element in sid is related to each seasonal cycle according to the same order in which the seasonal frequencies, w_j, are defined: $w_j = 2\pi j/S$, $j = 1, ..., Sh$, where S is the periodicity and Sh is `floor(frequency(x)/2)`. For example, in a monthly series: `sid=c(0,0,0,0,0,1)` returns the test statistic to the stability of the cycle with frequency $w_6 = \pi$; `sid=c(1,0,0,0,0,1)` returns the joint test statistic for cycles related to frequencies $w_1 = \pi/6$ and $w_6 = \pi$; `sid=c(1,1,1,1,1,1)` returns the joint test statistic for the stability of all seasonal cycles. The following keywords are also admitted: `sid="all"`, computes all the test statistic related to each individual season or cycle as well as the joint test statistic for all seasons or cycles; `sid="joint"` computes the joint test statistic for all seasons or cycles.

Value

A list of class `"CHtest"` with components:

`statistics`	the value of the test statistics.
`pvalues`	the p-values for each test statistics.
`method`	a character string describing the type of test.
`data.name`	a character string giving the name of the data.
`type`	the value of the input argument `type`.
`fitted.model`	the fitted regression model.
`NW.order`	the value of the input argument `NW.order`.
`isNullxreg`	logical, auxiliary element for `print` method. Were external regressors defined in the argument `xreg`?
`type.pvalue`	character, the value of the input argument `pvalue`.
`pvlabels`	a vector of characters containing a label related to each p-values. Auxiliary element for `print` method.

The method `print` displays the test statistics and p-values; `summary` shows the same output and includes the fitted regression model.

Note

When `type = "dummy"`, the p-value for the joint test statistic based on response surface regressions is not available. If `pvalue = "RS"`, the p-value reported for the joint test statistic in the trigonometric version is based on the tables given in the reference paper, Canova and Hansen (1995).

When `sid` is a numeric (selected combination of dummies or cycles), the reported p-values are based on interpolation in tables; if `pvalue = "RS"`, it is changed to `"raw"` and a warning is given.

References

Canova, F. and Hansen, Bruce E. (1995) "Are seasonal patterns constant over time? A test for seasonal stability". *Journal of Business & Economic Statistics*, **13**(3), pp. 237-252. DOI: doi:10.1080/07350015.1995.10524598.

Díaz-Emparanza, I. and Moral, M. P. (2013). *Seasonal stability tests in gretl. An application to international tourism data*. Working paper: Biltoki D.T. 2013.03. URL: `https://addi.ehu.es/handle/10810/10577`. Gretl code: https://www.ehu.eus/ignacio.diaz-emparanza/packages/Canova_Hansen.gfn (seems unavailable, so not linked)

See Also

ch.rs.pvalue seasonal.cycles, seasonal.dummies, uroot.raw.pvalue.

Examples

```
library(uroot)
# example for the series "hours" with the same options
# employed in Canova and Hansen (1995)
data("ch-data")
hours <- diff(log(ch.data$hours))
res1 <- ch.test(x = hours, type = "dummy", lag1 = TRUE, NW.order = 4)
res1
# the auxiliary regression is stored in the element "fitted.model"
summary(res1$fit)

## Not run:
# this requires tables not included in the current version of the package
# see note in main documentation file, uroot-package
res2 <- ch.test(x = hours, type = "trigonometric", lag1 = TRUE, NW.order = 4)
res2
summary(res2$fit)
## End(Not run)
```

---

hegy.boot.pval — *Bootstrapped P-Values for the HEGY Test Statistics*

Description

Compute p-values for the HEGY test statistics by means of bootstrap.

Usage

```
hegy.boot.pval(x, model0, stats0,
  deterministic = c(1,0,0), lag.method = c("fixed", "AIC", "BIC"), maxlag = 0,
  byseason = FALSE, nb = 500, u = NULL, debug.tid = -1)
```

Arguments

x	a univariate seasonal time series.
model0	the fitted.model returned by hegy.test for the original data.
stats0	the statistics returned by hegy.test for the original data.
deterministic	a vector of length three containing zeros or ones to indicate, respectively, whether a constant, a trend or seasonal dummies are included in the regression equation of the test.
lag.method	a character specifying the lag order selection method.
maxlag	the maximum lag order to be considered by lag.method.

byseason: logical, should the residuals be resampled by season? If `TRUE`, the residuals are split by the season they belong to and resampled accordingly; otherwise, the entire series of residuals is resampled regardless of the season they belong to.

nb: the number of bootstrap replicates.

u: optional matrix of integers giving the indices of the resampled residuals. Intended for debugging.

debug.tid: numeric, if positive, the bootstrap replicate of the data generated at iteratin `debug.tid` is returned (intended for debugging).

Details

See `hegy.test` for further details about the arguments that have the same name in both functions (`deterministic`, `lag.method`, `maxlag`).

Bootstrapped p-values follow the approach described in Burridge and Robert Taylor (2004), except that here, the residuals are resampled regardless of the season they belong to.

Value

A numeric vector containing the p-values of the the test statistics. The vector is named following the same convention as `statistics` and `pvalues` returned by `hegy.test`.

If the number of bootstrap replicates is `nb = 1`, the resampled series is returned (relevant for inspection of how the resampled series look like and for debugging).

References

Burridge, P. and Taylor, R. (2004) "Bootstrapping the HEGY seasonal unit root tests." *Journal of Econometrics* **123**(1), pp. 67-87. DOI: doi:10.1016/j.jeconom.2003.10.029.

Hylleberg, S., Engle, R., Granger, C. and Yoo, B. (1990) "Seasonal integration and cointegration." *Journal of Econometrics* **44**(1), pp. 215-238. DOI: doi:10.1016/03044076(90)90080D.

See Also

`hegy.test`.

Examples

```
## Not run:
x <- bgt.data[["LCONSEXPCO"]]
# this requires CUDA capable GPU
hegy.test(x, deterministic = c(1,1,1), lag.method = "fixed", maxlag = 1,
  pvalue = "bootstrap")
# alternatively, full R non-parallel version
res <- hegy.test(x, deterministic = c(1,1,1), lag.method = "fixed", maxlag = 1)
hegy.boot.pval(x, res$fit, res$stat, deterministic = c(1,1,1),
  lag.method = "fixed", maxlag = 1, nb = 1000)
## End(Not run)
```

hegy.rs.pvalue — *P-values based on response surface regressions for the HEGY test statistics*

Description

Compute p-values for the Hylleberg, Engle, Granger and Yoo (HEGY) test statistic by interpolation in precompiled response surfaces.

Usage

```
hegy.rs.pvalue(x, type = c("zero", "pi", "pair", "seasall", "all"),
  deterministic = c(1, 0, 0), lag.method = c("fixed", "AIC", "BIC"),
  lag.order, S, n, nobsreg)
```

Arguments

`x`	a numeric, the value of the HEGY statistic.
`type`	a character, the type of test statistic, the regressor(s) to which the statistic is related.
`deterministic`	a vector of length three containing zeros and ones to indicate, respectively, whether a constant, a trend or seasonal dummies should be included in the regression equation of the test.
`lag.method`	a character specifying the lag order selection criterion.
`lag.order`	a numeric, the lag order employed in the auxiliary regression.
`S`	numeric, the periodicity of the data.
`n`	numeric, the number of observations.
`nobsreg`	an integer indicating the number of points employed in the response surface regression.

Details

Ported from Gretl code provided by Díaz-Emparanza (2014).

The original source includes tables with coefficients for the calculation of p-values when the HQC lag order selection criterion is used. These tables are not included here.

The case with no deterministic terms (`deterministic = c(0,0,0)`) is not considered.

This function is mainly intended to be used internally by `hegy.test`.

Value

A numeric, the p-value.

References

Díaz-Emparanza, I. (2014) "Numerical Distribution Functions for Seasonal Unit Root Tests"- *Computational Statistics and Data Analysis* **76**, pp. 237-247. DOI: doi:10.1016/j.csda.2013.03.006. Gretl code: https://www.ehu.eus/ignacio.diaz-emparanza/packages/Canova_Hansen.gfn/ (seems unavailable, so not linked)

See Also

`hegy.test`.

`hegy.test` *Hylleberg, Engle, Granger and Yoo Test for Seasonal Unit Roots*

Description

Hylleberg, Engle, Granger and Yoo (HEGY) test statistics for the null hypothesis seasonal unit roots.

Usage

```
hegy.test(x, deterministic = c(1,0,0),
  lag.method = c("fixed", "AIC", "BIC", "AICc"), maxlag = 0,
  pvalue = c("RS", "bootstrap", "raw"), rs.nobsreg = 15,
  boot.args = list(seed = 123, lag.method = lag.method[1], maxlag = maxlag,
    byseason = FALSE, nb = 1000, BTdim = c(100, 10), debug.tid = -1))

hegy.regressors(x)
```

Arguments

`x`	a univariate seasonal time series.
`deterministic`	a vector of length three containing zeros or ones to indicate, respectively, whether a constant, a trend or seasonal dummies are included in the regression equation of the test.
`lag.method`	a character specifying the lag order selection method.
`maxlag`	the maximum lag order to be considered by `lag.method`.
`pvalue`	a character specifying the method employed to compute p-values: `"RS"`, the default, interpolation based on response surface regressions; `"bootstrap"`, bootstrap; `"raw"` interpolation in the tables provided in the reference papers.
`rs.nobsreg`	an integer indicating the number of points employed in the response surface regression (only for `pvalue = "RS"`).
`boot.args`	a list containing the parameters employed in the bootstrap. See details below.

Details

The regression equation employed to obtain the tests statistics may include the following deterministic terms: a constant, a linear trend, seasonal dummies. These terms are selected by setting to 1 the corresponding element in the vector `deterministic`: `deterministic = c(0,0,0)` no deterministic components, `deterministic = c(1,0,0)` includes a constant, `deterministic = c(1,0,1)` a constant and seasonal dummies, `deterministic = c(1,1,0)` a constant and a trend and `deterministic = c(1,1,1)` includes the three components.

The regression equation may include lags of the dependent variable. When `lag.method = "fixed"`, the lag order is fixed to `maxlag`; otherwise, `maxlag` is the maximum number of lags considered in a lag selection procedure that minimises the `lag.method` criterion, which can be `AIC` or `BIC` or corrected AIC, `AICc`, obtained as $AIC + \frac{2k(k+1)}{n-k-1}$, where k is the number of parameters and n is the number of available observations in the model.

Response surface based p-values, `pvalue="RS"`, is not available with option `lag.method = "AICc"`.

P-values based on response surface regressions follow the method described in MacKinnon (1994), Harvey+vanDijk (2006) and Díaz-Emparanza (2014). Gretl code provided by Díaz-Emparanza (2014) has been ported to function `hegy.rs.pvalue`. Note: the case `deterministic = c(0,0,0)` is not considered; `NA`s are returned if p-values based on response surfaces are selected for that case.

Bootstrapped p-values follow the approach described in Burridge and Robert Taylor (2004). The following arguments can be defined in `boot.args`:

- `seed`: a numeric, the seed of the random generator employed for resampling the residuals.
- `lag.method`: a character, the lag order selection method. This is the same as `lag.method` employed in the original regression, except that here, the AIC, BIC and AICc are obtained upon the residual sums of squares rather than the likelihood value.
- `maxlag`: a numeric, maximum number of lags. Same behaviour as `maxlag` explained above for the original regression.
- `byseason`: logical, should the residuals be resampled by season? If `TRUE`, the residuals belonging to the same season are resampled (at each time t, the residuals belonging to the corresponding season at time t are resampled); otherwise, the entire series of residuals is resampled regardless of the season they belong to.
- `nb`: a numeric, the number of bootstrap replicates.
- `BTdim`: a vector of length two containing the number of blocks and the number of threads per block to be run on parallel on the GPU. The product of these two elements must be equal or greater than `nb`.
- `debug.tid`: an integer employed for debugging. Currently ignored.

By default `boot.args$lag.method` and `boot.args$maxlag` are set equal to the same options employed for the original data in arguments `lag.method` and `maxlag`; if the default options are desired, these values need not be explicitly defined in the list `boot.args`.

The standard definition of the AIC, BIC and AICc criteria is used for the original series. For the bootstrapped series, these criteria are defined upon the residual sum squares of the model:

$$\text{AIC} = n \log\left(\text{RSS}/n\right) + 2k$$

$$\text{BIC} = n \log(\text{RSS}/n) + k \log(n)$$

$$\text{AICc} = \text{AIC} + \frac{2k(k+1)}{n-k-1}$$

where RSS is the residual sum of squares, k is the number of parameters in the model and n is the number of available observations.

Given a maximum lag, `maxlag`, the first `maxlag` observations are removed before fitting the models to be compared by the selected criterion. In this way, all the models contain the same number of observations. Once the lag order is selected, the statistics are obtained using the entire sample (except those observations that are missed due to the eventually chosen lags).

The HEGY regressors were originally proposed in Hylleberg *etal.* (1990) for quarterly data. They are generalized to monthly series in Beaulieu and Miron (1993) and to weekly data in Cáceres (1996). Franses and Hobijn (1997) show tabulated values for bimonthly and biannual data as well as quarterly and monthly data. `hegy.rergessors` follows the expressions given in Smith *etal.* (2009), which define the regressors for a general periodicity of the time series.

Value

`hegy.test` returns a list of class `"HEGYtest"` with the following components:

- `statistics` the value of the test statistics.
- `pvalues` the p-values for each test statistics.
- `method` a character string describing the type of test.
- `data.name` a character string giving the name of the data.
- `fitted.model` the fitted regression model.
- `lag.method` a character, the lag order selection criterion.
- `lag.order` a numeric, the number of lags included in the regression.
- `strdet` a character, auxiliary element for `print` describing the deterministic elements that were selected.
- `type.pvalue` a character, the value of the input argument `pvalue`.
- `bootstrap` a list, parameter options employed in the bootstrap (if `pvalue = "bootstrap"`).
- `boot.chosen.lags` a vector, the lag orders chosen for each bootstrap replicate (if `pvalue = "bootstrap"` and `boot.args$lag.method != "fixed"`).
- `pvlabels` a vector of characters containing a label related to each p-values. Auxiliary element for `print` method.

The method `print` displays the test statistics and p-values; `summary` shows the same output and includes the fitted regression model; `residuals` returns the residuals from the regression model fitted to the original data.

`hegy.regressors` returns a matrix containing the HEGY regressors which are used to test null of unit root at different frequencies.

References

Beaulieu, J. J. Miron, J. A. (1993) "Seasonal unit roots in aggregate U.S. data." *Journal of Econometrics* **55**(1-2), pp. 305-328. DOI: doi:10.1016/03044076(93)90018Z.

Burridge, P. and Taylor, R. (2004) "Bootstrapping the HEGY seasonal unit root tests." *Journal of Econometrics* **123**(1), pp. 67-87. DOI: doi:10.1016/j.jeconom.2003.10.029.

Cáceres, J. J. (1996) "Contraste de raíces unitarias en datos semanales." *Estadística Española* **38**(41), pp. 139-159.

Díaz-Emparanza, I. (2014) "Numerical distribution functions for seasonal unit root tests"- *Computational Statistics and Data Analysis*, **76**, pp. 237-247. DOI: doi:10.1016/j.csda.2013.03.006. Gretl code: https://www.ehu.eus/ignacio.diaz-emparanza/packages/GHegy.gfn (seems unavailable, so not linked)

Franses, F. H. (1991) "Seasonality, non-stationarity and the forecasting of monthly time series." *International Journal of Forecasting* **7**(2), pp. 199-208. DOI: doi:10.1016/01692070(91)90054Y.

Franses, P. H. and Hobijn, H. (1997) "Critical values for unit root tests in seasonal time series." *Journal of Applied Statistics* **24**(1), pp. 25-47.

Harvey D. I. and van Dijk D. (2006). "Sample size, lag order and critical values of seasonal unit root tests." *Computational Statistics & Data Analysis*, **50**(10), 2734-2751. DOI: doi:10.1016/j.csda.2005.04.011.

Hylleberg, S., Engle, R., Granger, C. and Yoo, B. (1990) "Seasonal integration and cointegration." *Journal of Econometrics* **44**(1), pp. 215-238. DOI: doi:10.1016/03044076(90)90080D.

MacKinnon J. G. (1994). "Approximate asymptotic distribution functions for unit-root and cointegration tests." *Journal of Business and Economic Statistics*, **12**(2), 167-176. DOI: doi:10.1080/07350015.1994.10510005.

Smith, R. J., Taylor, A. M. R. and del Barrio Castro, T. (2009) "Regression-based seasonal unit roots."*Econometric Theory* **25**(2), pp. 527-560. DOI: doi:10.1017/S0266466608090166.

See Also

hegy.rs.pvalue, uroot.raw.pvalue.

Examples

```
x <- bgt.data[["LCONSEXPCO"]]
hegy.test(x, deterministic = c(1,1,1), lag.method = "fixed", maxlag = 1)

## Not run:
# this requires CUDA capable GPU
hegy.test(x, deterministic = c(1,1,1), lag.method = "fixed", maxlag = 1,
  pvalue = "bootstrap")
## End(Not run)
```

`seasonal.dummies` *Seasonal Dummies and Seasonal Cycles*

Description

Generate variables of seasonal dummies and seasonal cycles.

Usage

```
seasonal.dummies(x)
seasonal.cycles(x)
```

Arguments

x	a univariate seasonal time series.

Value

A multivariate time series containing the dummies or cycles by columns.

Examples

```
# In terms of model fitting
# both sets of variables are equivalent
x <- diff(log(AirPassengers))
sd <- seasonal.dummies(x)
fit1 <- lm(x ~ sd[,-1])
summary(fit1)
sc <- seasonal.cycles(x)
fit2 <- lm(x ~ sc)
summary(fit1)
all.equal(fitted(fit1), fitted(fit2))
```

`uroot.raw.pvalue` *Original Tables of Critical Values*

Description

Compute p-values by interpolation in the tables of critical values provided in the original references given below.

Usage

```
uroot.raw.pvalue(x, type = c("CH", "HEGY"), v, n, ctd, S, Ftpi)
```

Arguments

`x`	a numeric. The value of the CH statistic.
`type`	a character specifying the type of test statistic.
`v`	numeric, the degrees of freedom of the Von Mises distribution. Only for `type="CH"`.
`n`	numeric, the number of observations.
`ctd`	a character indicating the deterministic elements that were included in the HEGY regression. This argument is defined as `paste(deterministic, collapse = "")`, where `deterministic` is the argument of that name that was passed to `hegy.test`. Only for `type="ADF"` or `type="HEGY"`.
`S`	numeric, the periodicity of the data.
`Ftpi`	a character indicating whether the type of statistic: `"zero"`, t-test for the zero frequency; `"pi"`, t-test for the frequency π; `"pair"`, F-test for the pairs of complex conjugates frequencies. Only for `type="ADF"` or `type="HEGY"`.

Details

This function is used internally by `ch.test` and `hegy.test`.

Value

A numeric giving the calculated p-value.

References

Beaulieu, J. J. Miron, J. A. (1993) "Seasonal Unit Roots in Aggregate U.S. Data". *Journal of Econometrics*, **55**(1-2), pp. 305-328. DOI: doi:10.1016/03044076(93)90018Z.

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See Also

`ch.test`, `hegy.test`.

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