

Package ‘bootCT’

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Type Package

Title Bootstrapping the ARDL Tests for Cointegration

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Description The bootstrap ARDL tests for cointegration is the main functionality of this package. It also acts as a wrapper of the most common ARDL testing procedures for cointegration: the bound tests of Pesaran, Shin and Smith (PSS; 2001 - <[doi:10.1002/jae.616](https://doi.org/10.1002/jae.616)>) and the asymptotic test on the independent variables of Sam, McNown and Goh (SMG: 2019 - <[doi:10.1016/j.econmod.2018.11.001](https://doi.org/10.1016/j.econmod.2018.11.001)>). Bootstrap and bound tests are performed under both the conditional and unconditional ARDL models.

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boot_ardl	<i>Bootstrap ARDL</i>
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Description

This is the main function of the package. It performs the bootstrap version of the ARDL bound test for cointegration.

Usage

```
boot_ardl(
  data,
  yvar = NULL,
  Xvar = NULL,
  difflags = NULL,
  maxlag = 5,
  p.ardl = 0.05,
  p.vecm = 0.05,
  B = 2000,
  case = 3,
  crit.H0 = c(0.05, 0.025, 0.01),
  print = T
)
```

Arguments

data	Input dataset. Must contain a dependent and a set of independent variables.
yvar	Name of the dependent variable, enclosed in quotation marks. If NULL, the first variable will be used.
Xvar	Vector of names of the independent variables, each enclosed in quotation marks. If NULL, all variables except the first will be used.
difflags	Fixed lagged differences for the short term part of the ARDL equation.
maxlag	Max number of lags for the auto_ardl procedure.
p.ardl	Threshold p-value for the short-term ARDL coefficients significance in the bootstrap procedure.
p.vecm	Threshold p-value for the short-term VECM coefficients significance in the bootstrap procedure.
B	Number of bootstrap replications.
case	Model case, pertaining to the treatment of intercept and trend. Must be integer from 1 to 5. Defaults to 3.
crit.H0	Probability/ies by which the critical quantiles of the bootstrap distribution(s) must be calculated.
print	Show the progress bar.

Value

List of several elements including

- ARDL: the conditional and unconditional ARDL models applied on the data
- pssbounds: the PSS bound test output
- smgbounds: the SMG bound test critical values
- fov.st: the test statistics on the conditional and unconditional Fov tests
- t.st: the test statistics on the conditional and unconditional t tests
- find.st: the test statistics on the conditional and unconditional Find tests
- quantFOV: the bootstrap conditional and unconditional F Overall test critical value(s)
- quantt: the bootstrap conditional and unconditional t test critical value(s)
- quantFIND: the bootstrap conditional and unconditional F Independent test critical value(s)

Examples

```
## Not run:
data(ger_macro)
LNDATA = as.data.frame(log(ger_macro[,-1]))
colnames(LNDATA) = c("LNINVEST", "LNINCOME", "LNCONS")

boot_res = boot_ardl(LNDATA, yvar = "LNINCOME", Xvar = c("LNCONS", "LNINVEST"), maxlag = 5, B = 2000)
summary(boot_res)

## End(Not run)
```

ger_macro

Investment, Income and Consumption dataset.

Description

The data set contains quarterly, seasonally adjusted time series for West German fixed investment, disposable income, and consumption expenditures in billions of DM from 1960Q1 to 1982Q4. It was produced from file E1 of the data sets associated with Lutkepohl (2007). Originally obtained from Deutsche Bundesbank.

Usage

```
ger_macro
```

Format

A data frame with 92 rows and 4 variables:

DATE Quarter

INVEST Fixed investment (DM Billions)

INCOME Disposable income (DM Billions)

CONS Consumption expenditures (DM Billions)

Source

<http://www.jmulti.de/download/datasets/e1.dat>

lag_mts	<i>Create matrix of lagged variables</i>
---------	--

Description

This function lags a set of variables in a matrix, each with a separate index. It is also possible to retain only the last lag order.

Usage

```
lag_mts(X, k, last.only = F)
```

Arguments

X	numeric matrix whose columns are subject to lagging
k	vector of lag orders
last.only	If TRUE only the k-th order lag will be computed, otherwise all lags from 1 to k

Value

a matrix whose columns are the original variables and the k-th order lagged variables. Column name suffix ".lx".

Examples

```
data(ger_macro)

lag_mts(X = ger_macro, k = 3, last.only = FALSE)
```

sim_vecm_ardl	<i>Generate data from a VECM/ARDL equation</i>
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Description

This function generates a dataset following a VECM/ARDL model equation.

Usage

```

sim_vecm_ardl(
  nobs,
  case = 1,
  sigma.in = diag(3),
  gamma.in,
  Axx.in,
  ayxUC.in,
  ayy.in,
  mu.in,
  eta.in,
  azeroy.in = 0,
  aoney.in = 0,
  burn.in,
  seed.in = NULL
)

```

Arguments

nobs	number of observations.
case	case related to intercept and trend
sigma.in	error covariance matrix.
gamma.in	list of short-run parameter matrices
Axx.in	long-run relationships between the independent variables
ayxUC.in	long-run unconditional relationship between dependent and independent variables, $\mathbf{a}_{yx}^{(UC)}$. The second component ayxC, derived from conditioning, is calculated as $\mathbf{a}_{yx}^{(C)} = -\boldsymbol{\omega}'\mathbf{A}_{xx}$
ayy.in	long-run relationship for the dependent variable a_{yy}
mu.in	VAR intercept vector
eta.in	VAR trend vector
azeroy.in	Conditional ARDL intercept. Overridden if CASE I or CASE II
aoney.in	Conditional ARDL trend. Overridden if CASE IV
burn.in	burn-in number of observations
seed.in	optional seed number for random error generation.

Value

A list that includes

- dims: a vector with the dataset dimension
- case: the case given as input
- data: the generated data
- diffdata: the data first difference
- ut: the generated random error matrix.

- sigma: the error covariance matrix Σ .
- omega: the ω vector of parameters generated via conditioning
- At: the conditional long-run parameter matrix \tilde{A}
- ayx1: the unconditional subvector of the ARDL equation $a_{y.x}^{UC}$
- ayx: the conditional subvector of the ARDL equation $a_{y.x} = a_{y.x}^{UC} - \omega' A_{xx}$
- gammalist: the list of unconditional Γ_j parameter matrices
- psilist: the list of conditional $\psi_{y.x,j}$ parameter matrices
- azero: the unconditional VECM intercept
- azero.c: the conditional VECM intercept
- interc.ardl: the conditional ARDL intercept
- aone: the unconditional VECM trend
- aone.c: the conditional VECM trend
- interc.ardl: the conditional ARDL trend
- vmu: the VAR intercept
- veta: the VAR trend

Examples

```
#PARAMETERS

#Sigma
corr = matrix(0, ncol = 3, nrow = 3)
corr[2,1] = 0.25
corr[3,1] = 0.4
corr[3,2] = -0.25
Corr = (corr + t(corr)) + diag(3)
sds = diag(c(1.3, 1.2, 1))
Sigma = (sds %*% Corr %*% t(sds))

#Gamma
gammalist=list()
gammalist[[1]] = matrix(c(0.6, 0, 0.2, 0.1, -0.3, 0, 0, -0.3, 0.2), nrow = 3, ncol = 3, byrow = TRUE)
gammalist[[2]] = matrix(c(0.2, 0, 0.1, 0.05, -0.15, 0, 0, 0, 0.1), nrow = 3, ncol = 3, byrow = TRUE)

#DATA GENERATION
data_sim = sim_vecm_ardl(nobs = 200,
                        case = 3,
                        sigma.in = Sigma,
                        gamma.in = gammalist,
                        Axx.in = matrix(c(0.3, 0.5, 0.4, 0.3), nrow = 2, ncol = 2),
                        ayxUC.in = c(0.5,0.6),
                        ayy.in = 0.7,
                        mu.in = rep(0.3, 3),
                        eta.in = rep(0, 3),
                        azeroy.in = 0.4,
                        aoney.in = 0,
                        burn.in = 50,
```

```
seed.in = 10)
```

smk_crit	<i>Critical values of the F-test on the independent variables in the conditional ARDL model.</i>
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Description

This internal data contains critical values of the Find test of Sam et al (2018), for several sample sizes and lag orders. Applicable only for cases I, III, and V. Critical values at significance levels 1%, 2.5%, 5% and 10%.

Usage

```
smk_crit
```

Format

A data frame with 144 rows and 17 variables

case case related to intercept and trend specification. Only I, III or V

prob significance levels. 0.01, 0.025, 0.05 or 0.10

num sample size, 30 to 80 and beyond for asymptotic critical values

I0_x right threshold for accepting the null of zero coefficients in the Find test. x: 1 to 7

I1_x left threshold for rejecting the null of zero coefficients in the Find test. x: 1 to

summary.bootCT	<i>Summary method</i>
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Description

This function summarizes the ARDL bootstrap test and all the other asymptotic procedures all together.

Usage

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

Arguments

object	an object of class "bootCT"
...	not parsed, added for compatibility

Value

the function returns a list of summary statistics, already present in the function `boot_ard1`, and displays them in an appropriate manner.

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