Package 'dynamac'

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Title Dynamic Simulation and Testing for Single-Equation ARDL Models

Version 0.1.5

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Description While autoregressive distributed lag (ARDL) models allow for extremely flexible dynamics, interpreting substantive significance of complex lag structures remains difficult. This package is designed to assist users in dynamically simulating and plotting the results of various ARDL models. It also contains post-estimation diagnostics, including a test for cointegration when estimating the error-correction variant of the autoregressive distributed lag model (Pesaran, Shin, and Smith 2001 <doi:10.1002/jae.616>).

URL https://github.com/andyphilips/dynamac/

BugReports https://github.com/andyphilips/dynamac/issues

Imports MASS, lmtest

Suggests urca, knitr, rmarkdown, testthat

Depends R (>= 3.0.1)

License GPL (>=2)

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VignetteBuilder knitr

NeedsCompilation no

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R topics documented:

`area.simulation.plot` *Create an area plot of a simulated response in a dynardl model*

Description

Create an area plot of a simulated response in a dynardl model

Usage

```
area.simulation.plot(x, response = "levels", bw = FALSE)
```

Arguments

`x`	a dynardl model with a simulation to be plotted
`response`	whether the plot of the response should be shown in levels of the dependent variable (`levels`) or in changes from the mean of the dependent variable (`mean.changes`). The default is `levels`
`bw`	should the colors be in black and white (for publication)? The default is `FALSE`

Details

When running `dynardl`, `simulate` must be true so that there is a simulation to plot.

Value

an area plot

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
# Using the ineq data in dynamac
# Shocking Income Top 10
ardl.model <- dynardl(concern ~ incshare10 + urate, data = ineq,
       lags = list("concern" = 1, "incshare10" = 1),
       diffs = c("incshare10", "urate"),
       lagdiffs = list("concern" = 1),
       ec = TRUE, simulate = TRUE, range = 30,
       shockvar = "incshare10")
area.simulation.plot(ardl.model) # Shows absolute levels
area.simulation.plot(ardl.model, response = "mean.changes")  # Shows changes from mean level
area.simulation.plot(ardl.model, bw = TRUE)  # Grayscale plots
```

dshift *Take first difference of a series.*

Description

Take first difference of a series.

Usage

```
dshift(x)
```

Arguments

x	a series to be differenced

Details

dshift assumes that the series are ordered, that there is no missing data, and that the time intervals are even.

Value

the differenced series

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
x.var <- seq(0, 50, 5)
d.x.var <- dshift(x.var)
head(x.var)
head(d.x.var)
```

dynardl *Estimate and Simulate ARDL Model*

Description

Estimate autoregressive distributed lag model and simulate interesting values (if desired)

Usage

```
dynardl(formula, data = list(), lags = list(), diffs = list(),
  lagdiffs = list(), levels = list(), ec = FALSE, trend = FALSE,
  constant = TRUE, modelout = FALSE, simulate = FALSE,
  shockvar = list(), shockval = sd(data[[shockvar]]), time = 10,
  qoi = "mean", forceset = NULL, range = 20, burnin = 20,
  sims = 1000, sig = 95, expectedval = FALSE)
```

Arguments

formula	a symbolic description of the model to be estimated. ARDL models are estimated using linear regression.
data	an optional data frame or list containing the the variables in the model.
lags	a list of variables and their corresponding lags to be estimated.
diffs	a vector of variables to be differenced. Only first differences are supported.
lagdiffs	a list of variables to be included in lagged differences.
levels	a vector of variables to be included in levels.
ec	estimate model in error-correction form, (i.e., y appears in first-differences). By default, ec is set to FALSE, meaning y will appear in levels.
trend	include a linear time trend. The default is FALSE.
constant	include a constant. The default is TRUE.
modelout	print the regression estimates in the console
simulate	simulate the reponse. Otherwise, just the regression model will be estimated. If simulate = FALSE, options shockvar, shockval, time, qoi, forceset, range, burnin, sims, sig, and expectedval, are ignored. The default is FALSE.
shockvar	the variable to be shocked. There is no default.
shockval	the amount by which the shockvar should be shocked. The default is one standard deviation of the shocked variable.
time	the time period in the simulation for the variable to be shocked.
qoi	summarize the response of the dependent variable with the mean or the median. Although the default is mean, if there is underlying skew in the distribution, it might be better summarized by median.
forceset	by default, in the simulations, variables in levels will be set to their means; variables in differences will be set to 0. Alternatively, users can set any variable in the model to a different value using a list in forceset. These values can be any user-defined value, including means, medians, percentiles, or other values of interest.
range	the range of the simulation to be conducted
burnin	the number of time periods to disregard before recording the values. These do not include the range; in other words, they take place before the range specified above. Users can increase the number of burnin periods, but probably should not decrease them. The default is 20.
sims	the number of simulations to use in creating the quantities of interest (the response of the dependent variable). The default is 1000.
sig	the significance level (1 - p) that the user wants for the simulations. The default level is 95% significance (sig = 95)
expectedval	if this is TRUE, the simulation will record the expected values of across the sims by averaging errors. We recommend setting it to FALSE, since expected values do not account for stochastic error present in the model itself.

Details

Estimate an auto-regressive distributed lag model. Moreover, enable a graphical interpretation of the results (through area.simulation.plot or spike.simulation.plot) by simulating the response of the dependent variable to shocks in one of the regressors.

Value

dynardl should always return an estimated model. It may or may not be simulated, according to the user. But the relevant regression output, model residuals (which can be tested for autocorrelation), and simulated response (if created) are stored in a list if the model is assigned to an object.

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
# Using the inequality data from dynamac
ardl.model <- dynardl(concern ~ incshare10 + urate, data = ineq,
       lags = list("concern" = 1, "incshare10" = 1),
       diffs = c("incshare10", "urate"),
       ec = TRUE, simulate = FALSE)
summary(ardl.model)

# Adding a lagged difference of the dependent variable
ardl.model.2 <- dynardl(concern ~ incshare10 + urate, data = ineq,
       lags = list("concern" = 1, "incshare10" = 1),
       diffs = c("incshare10", "urate"),
       lagdiffs = list("concern" = 1),
       ec = TRUE, simulate = FALSE)
summary(ardl.model.2)

# Does not work: levels and diffs must appear as a vector

ardl.model.3 <- dynardl(concern ~ incshare10 + urate, data = ineq,
       lags = list("concern" = 1, "incshare10" = 1),
       levels = list("urate" = 1),
       diffs = list("incshare10" = 1, "urate" = 1),
       lagdiffs = list("concern" = 1),
       ec = TRUE, simulate = FALSE)


ardl.model.3 <- dynardl(concern ~ incshare10 + urate, data = ineq,
       lags = list("concern" = 1, "incshare10" = 1),
       levels = c("urate"),
       diffs = c("incshare10", "urate"),
       lagdiffs = list("concern" = 1),
       ec = TRUE, simulate = FALSE)
```

---

dynardl.auto.correlated

Run a variety of autocorrelation tests on the residuals from a dynardl *model.*

Description

Run a variety of autocorrelation tests on the residuals from a dynardl model.

Usage

```
dynardl.auto.correlated(x, bg.type = "Chisq", digits = 3,
  order = NULL, object.out = FALSE)
```

Arguments

x	a dynardl model
bg.type	a character string for the type of Breusch-Godfrey test to run. The default is Chisq: the Chisq test statistic. The other option is F: the F-test statistic.
digits	the number of digits to round to when showing output. We recommend three.
order	the maximum order of serial autocorrelation to test when executing the Breusch-Godfrey test.
object.out	if TRUE, and dynardl.auto.correlated is assigned to an object, the AIC, BIC, and results will be stored for the user's convenience.

Details

This is a simple and convenient way to test whether the residuals from the dynardl model are white noise. As an aside, this is also why dynardl has a simulate = FALSE argument: users can ensure the model has white noise residuals before estimating a potentially time-intensive simulation. The output also reminds the user of the null hypotheses for the autocorrelation tests.

Value

The results of autocorrelation tests.

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
# Using the ineq data from dynamac
ardl.model <- dynardl(concern ~ incshare10 + urate, data = ineq,
       lags = list("concern" = 1, "incshare10" = 1),
       diffs = c("incshare10", "urate"),
       lagdiffs = list("concern" = 1),
       ec = TRUE, simulate = FALSE)
dynardl.auto.correlated(ardl.model)
```

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france.data *Data on French Energy Consumption and GDP*

Description

Data on GDP are from World Bank World Development Indicators. Data on energy consumption are from the PB Statistical Review of World Energy (June 2018).

Usage

```
data(france.data)
```

Format

A data frame with 53 rows and 4 variables:

country Country

year Year

lnGDP_cons2010USD ln(GDP), constant 2010 US dollars

lnenergy ln(energy consumption), mill. tons oil equiv.

---

ineq *Data on public concern about economic inequality*

Description

A dataset from: Wright, Graham. 2017. "The political implications of American concerns about economic inequality." Political Behavior 40(2): 321-346.

Usage

```
data(ineq)
```

Format

A data frame with 49 rows and 9 variables:

year Year

mood Public mood liberalism

urate Unemployment rate

concern Concern about economic inequality

demcontrol Democratic control of congress

incshare10 Proportion of income of top 10 percent

csentiment Consumer sentiment

incshare01 Proportion of income of top 1 percent

Source

http://dx.doi.org/10.7910/DVN/UYUU9G

ldshift *Take the lagged first difference of a series.*

Description

Take the lagged first difference of a series.

Usage

```
ldshift(x, l)
```

Arguments

x	a series to be differenced
l	the number of lags

Details

`ldshift` assumes that the series are ordered, that there is no missing data, and that the time intervals are even.

Value

the lagged differenced series

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
x.var <- runif(50)
ld.1.x.var <- ldshift(x.var, 1)
ld.2.x.var <- ldshift(x.var, 2)
head(x.var)
head(ld.1.x.var)
head(ld.2.x.var)
```

lshift *Take lag transformation of a series.*

Description

Take lag transformation of a series.

Usage

```
lshift(x, l)
```

Arguments

x	a series to be lagged
l	the number of lags

Details

`lshift` assumes that the series are ordered, that there is no missing data, and that the time intervals are even.

Value

the lagged series

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
x.var <- runif(50)
l.1.x.var <- lshift(x.var, 1)
l.2.x.var <- lshift(x.var, 2)
head(x.var)
head(l.1.x.var)
head(l.2.x.var)
```

---

pssbounds *Perform Pesaran, Shin and Smith (2001) cointegration test*

Description

Perform Pesaran, Shin and Smith (2001) cointegration test

Usage

```
pssbounds(data = list(), obs = NULL, fstat = NULL, tstat = NULL,
  case = NULL, k = NULL, digits = 3, object.out = FALSE)
```

Arguments

data	an optional dynardl model. We highly recommend this option. Users are of course welcome to determine their own Case, t-statistic, F-statistic, and observations, but it is easier to have the model determine these quantities.
obs	number of observations
fstat	F-statistic of the joint test that variables in levels (except the lagged dependent variable) are equal to zero: `l.y = l.x1 + l.x2 +...+l.xk = 0`
tstat	t-statistic of the lagged dependent variable
case	specify certain restrictions on the constant and trend terms, since critical values differ by case. Case I: no intercept or trend, Case II: restricted intercept, no trend, Case III: unrestricted intercept with no trend, Case IV: unrestricted intercept and restricted trend, Case V: unrestricted intercept and trend. Case III is most frequently specified

k	number of regressors appearing in levels in the estimated model
digits	the number of digits to round to when showing output. We recommend three.
object.out	if TRUE, and dynardl.auto.correlated is assigned to an object, the AIC, BIC, and results will be stored for the user's convenience.

Details

pssbounds performs post-estimation cointegration testing using the bounds testing procedure from Pesaran, Shin, and Smith (2001). Since test statistics vary based on the number of k regressors, length of the series, these are required, in addition to F- and t-statistics.

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
# Using the ineq data from dynamac
# We can get all the values by hand
ardl.model <- dynardl(concern ~ incshare10 + urate, data = ineq,
        lags = list("concern" = 1, "incshare10" = 1),
        diffs = c("incshare10", "urate"),
        lagdiffs = list("concern" = 1),
       ec = TRUE, simulate = FALSE)
summary(ardl.model)
pssbounds(obs = 47, fstat = 7.01578, tstat = -3.223, case = 3, k = 1)

# Or just pass a dynardl model.
pssbounds(ardl.model)
```

---

spike.simulation.plot *Create a spike plot of a simulated response in a dynardl model*

Description

Create a spike plot of a simulated response in a dynardl model

Usage

```
spike.simulation.plot(x, response = "levels", bw = FALSE)
```

Arguments

x	a dynardl model with a simulation to be plotted
response	whether the plot of the response should be shown in levels of the dependent variable (levels) or in changes from the mean of the dependent variable (mean.changes). The default is levels
bw	should the colors be in black and white (for publication)? The default is FALSE

Details

When running dynardl, simulate must be true so that there is a simulation to plot.

Value

a spike plot

Author(s)

Soren Jordan and Andrew Q. Philips

Examples

```
# Using the ineq data in dynamac
# Shocking Income Top 10
ardl.model <- dynardl(concern ~ incshare10 + urate, data = ineq,
       lags = list("concern" = 1, "incshare10" = 1),
       diffs = c("incshare10", "urate"),
       lagdiffs = list("concern" = 1),
       ec = TRUE, simulate = TRUE, range = 30,
       shockvar = "incshare10")
spike.simulation.plot(ardl.model)  # Shows absolute levels
spike.simulation.plot(ardl.model, response = "mean.changes")  # Shows changes from mean level
spike.simulation.plot(ardl.model, bw = TRUE)  # Grayscale plots
```

---

supreme.sup *Data on US Supreme Court Approval*

Description

A dataset from: Durr, Robert H., Andrew D. Martin, and Christina Wolbrecht. 2000. "Ideological divergence and public support for the Supreme Court." American Journal of Policial Science 44(4): 768-776.

Usage

```
data(supreme.sup)
```

Format

A data frame with 42 rows and 9 variables:

dcalc Supreme Court support

l_dcalc Lagged Supreme Court spport

iddiv Ideological divergence

mooddev Mean deviation of Mood

dirdev Mean deviation of percent liberal decisions

sg Rulings against Solicitor General's amicus briefs

laws Laws declared unconstitutional

presapp Approval of president

congapp Approval of Congress

Source

https://sites.lsa.umich.edu/admart/replication/

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