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Type Package

Title Linear and Nonlinear Autoregressive Distributed Lag Models: General-to-Specific Approach

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Description Estimate the linear and nonlinear autoregressive distributed lag (ARDL & NARDL) models and the corresponding error correction models, and test for longrun and short-run asymmetric. The general-to-specific approach is also available in estimating the ARDL and NARDL models. The Pesaran, Shin & Smith (2001) (<doi:10.1002/jae.616>) bounds test for level relationships is also provided. The 'ardl.nardl' package also performs short-run and longrun symmetric restrictions available at Shin et al. (2014) <doi:10.1007/978-1-4899-8008-3_9> and their corresponding tests.

Maintainer Eric I. Otoakhia <otoakhiai@gmail.com>

Author Eric I. Otoakhia [aut, cre]

Contact <otoakhiai@gmail.com>

License GPL (>= 2)

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Contents

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ardl.nardl-package	*Linear and Nonlinear Autoregressive Distributed Lag Models: General-to-Specific Approach*

Description

Estimate the linear and nonlinear autoregressive distributed lag (ARDL & NARDL) models and the corresponding error correction models, and test for longrun and short-run asymmetric. The Pesaran, Shin & Smith (2001) Bounds test for level relationships is also provided with the aid of Jordan and Philips (2020) pssbounds function. In addition, the 'ardl.nardl' package also performs short-run and longrun symmetric restrictions available at Shin et al. (2014) and their corresponding tests.

References

Jordan S, Philips A (2020). _dynamac: Dynamic Simulation and Testing for Single-Equation ARDL Models_. R package version 0.1.11

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326. https://doi.org/10.1002/jae.616

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In: Sickles, R., Horrace, W. (eds) Festschrift in Honor of Peter Schmidt. Springer, New York, NY. https://doi.org/10.1007/978-1-4899-8008-3_9

Examples

```
## Not run:
data(fuel_price)
data(expectation)
 out1 <- gets_ardl_uecm(x = expectation,
                        dep_var = c('nq_inf_exp'),
                        expl_var = c('food_inf','nethawkish'),
                        p_order = c(4),
                        q_order = c(5,7),
                        gets_pval = 0.1,
                        case = 4,
                        graph_save = FALSE,
                        F_HC = FALSE,
                        order_l = 7)
 out1

 out2 <- gets_nardl_uecm(x = expectation,
                          decomp = 'food_inf',
                          dep_var = 'nq_inf_exp',
                          control = 'nethawkish',
                          c_q_order = c(3),
                          p_order = c(3),
                          q_order = c(3),
                         gets_pval = 0.1,
                          graph_save = FALSE,
                          case = 5,
                          F_HC = FALSE)
 out2

OUT3 <- auto_case_ardl(x = expectation,
                dep_var = 'n12m_inf_exp',
                expl_var = c('food_inf',"hawkish","dovish"),
                p_order = 2,
                q_order = c(4,4,4),
                gets_pval = 0.05,
                graph_save = FALSE,
                order_l = 7)
OUT3

OUT4 <- nardl_auto_case(x = fuel_price,
                        decomp =  'wti',
                        dep_var = 'fpp',
                        control = 'bdc',
                        c_q_order = c(5),
                        p_order = c(5),
                        q_order = c(6),
                        gets_pval = 0.1,
                        order_l = 4,
                        graph_save = FALSE)
OUT4

uecm_case3 <- ardl_uecm(x = fuel_price,
```

```
                                    dep_var = c('fpp'),
                                    expl_var = c('bdc', 'wti'),
                                    p_order =c(6),
                                    q_order =c(5,3),
                                    graph_save = FALSE,
                                    case = 3)
uecm_case3

output_n1_case5 <- nardl_uecm(x = fuel_price,
                                    decomp  = c('bdc'),
                                    control =c('wti'),
                                    c_q_order = c(2),
                                    p_order = c(3),
                                    q_order = c(5),
                                    dep_var = c('fpp'),
                                    graph_save = FALSE,
                                    case = 5)
output_n1_case5

data(syg_data)
out_srsr <- nardl_uecm_sym(x = syg_data,
                decomp  = 'ca_u',
                assumption = c('SRSR'),
                control =NULL,
                p_order =5,
                q_order =3,
                dep_var = 'ca_ip',
                graph_save = FALSE,
                case = 3)
out_srsr

out_lrsr <- nardl_uecm_sym(x = syg_data,
                            decomp  = 'ca_u',
                            assumption = c('LRSR'),
                            control =NULL,
                            p_order =5,
                            q_order =3,
                            dep_var = 'ca_ip',
                            graph_save = FALSE,
                            case = 3)
out_lrsr

## End(Not run)
```

ArchTest   *Import from package* **nardl**

Description

The ArchTest object is imported from package **nardl**. Help is available here: `nardl::ArchTest`.

---

ardl_uecm   *Estimate the ARDL and ARDL Error Correction Model.*

Description

Estimate ARDL and ARDL error correction model, conduct the bounds test for cointegration

Usage

```
ardl_uecm(x, p_order = c(2), q_order, dep_var, order_l = 4,
    graph_save = FALSE, expl_var, case = 3)
```

Arguments

x	A dataframe object. S3 dataframe object not applicable.
p_order	is the lag for the dependent variable (dep_var). Default value is c(2)
q_order	A numeric vector containing the lags for each explanatory variable. A vector of two lags (i.e c(3,4)) which corresponds to the expl_var (say c('x1','x2') where x1 has lag of 3 and x2 has lag of 4).
dep_var	Character vector containing one dependent variable
order_l	Positive integer. lag for the order of serial correlation and ARCH test.
graph_save	Logical (default is FALSE). If TRUE, stability plot is displayed as well.
expl_var	Character vector containing the explanatory variable(s).
case	A numerical vector that can take a value between 1 to 5. The default value is 3.

Value

ARDL_fit	This display the ARDL lm fit
ARDL_ECM_fit	This display the ARDL ECM lm fit
UECM	This display the summary results of the estimated unrestricted error correction models
UECM	This display the summary results of the estimated linear unrestricted error correction models
cointegration	This presents the Pesaran, Shin, and Smith (2001) cointegration test. The critical F and t statistics obtained if the sample is greater than 80 are asymptotic. If you adopt this segment, please consider citing Pesaran et al (2001) and Jordan and Philips (2020) dynamac package. If the sample is less than or equal to 80, for case 1, the F and t statistics adopted are large sample asymptotic critical value (CV) and no small-sample asymptotic critical value available. When case = 3 or 5, the critical value of F statistic is small sample asymptotic, and the adopted t statistics are large sample asymptotic CV. Consider including Narayan (2005) in your citation list. If the sample is greater than 80, for case 1, 3 and 5, large sample asymptotic CV for F and t statistics are adopted. In case 2 and 4, for sample <= 80, the F statistic are small sample asymptotic and no asymptotic CV for the t statistic. If sample > 80, for case 2 and 4, large sample asymptotic CV for F is adopted and no t-statistic CV.

Longrun_relation

> The estimated longrun relations

diagnostics test

> The diagnostic tests indicate the Breusch-Godfrey test for higher-order serial correlation (BG_SC_lm_test). The Engle (1982) test for conditional heteroscedasticity (LM_ARCH_test). The test for non-normality is that of Jarque and Bera (1980). The RESET null hypothesis adopted implies - including the 2nd - degree terms improve the fit (over the model specified). This ARCH LM function is derived from Zaghdoudi (2018)

References

Jordan S, Philips A (2020). _dynamac: Dynamic Simulation and Testing for Single-Equation /n ARDL Models_. R package version 0.1.11

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. Applied economics, 37(17), 1979-1990.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Zaghdoudi, T. (2018). nardl: Nonlinear Cointegrating Autoregressive Distributed Lag Model_. R package version 0.1.5

See Also

gets_ardl_uecm gets_nardl_uecm nardl_uecm nardl_uecm_sym

Examples

```
data(fuel_price)
uecm_case3 <- ardl_uecm(x = fuel_price,
                        p_order =c(6),
                        q_order =c(5,3),
                        dep_var = c('fpp'),
                        expl_var = c('bdc', 'wti'),
                        graph_save = FALSE,
                        case = 3)
uecm_case3
uecm_case3$cointegration
uecm_case3$Longrun_relation
uecm_case3$`diagnostics test`

uecm_case2 <- ardl_uecm(x = fuel_price,
                        p_order =c(3),
                        q_order =c(4),
                        dep_var = c('fpp'),
                        expl_var = c('wti'),
                        graph_save = TRUE,
                        case = 2)
uecm_case2
uecm_case2$cointegration
uecm_case2$Longrun_relation
```

```
uecm_case2$`diagnostics test`
```

---

auto_case_ardl   *Obtain the best ARDL model specification and bounds test.*

Description

This function finds the best ARDL model specification and conduct bounds test by relying on the
general to specific approach.

Usage

```
auto_case_ardl(x, dep_var, expl_var, p_order, q_order,
gets_pval = 0.05, order_l = 3, graph_save = FALSE)
```

Arguments

x	Dataframe.
dep_var	A Character vector that contain the response variable.
expl_var	Character vector containing the list of explanatory variable(s).
p_order	An integer. Lag differenced adopted for the differenced response variable
q_order	An integer. Lag differenced adopted for the differenced explanatory variable(s)
gets_pval	The p- value which served as the criteria for eliminating non-significant variable in the course of obtaining the best model based on the Schwarz information criteria.
order_l	Integer. Needed for the autocorrelation and heteroscedasticity test
graph_save	Logical. If TRUE, displays the stability plots

Details

The procedure of the general-to-specific approach in obtaining the parsimonious model involves
conducting the multi-path backwards elimination; tests both single and multiple hypothesis tests,
diagnostics tests and goodness-of-fit measures. See page 5 of Sucarrat, (2021) for more details.

The value for gets_pval is influential the final model based on the multipath backward elimination.
For more details on the general-to-specific approach, see the vignette of the 'gets' package.

Value

```
Parsimonious_ARDL_fit
```
                  Return an estimated general-to-specific ARDL model
```
Parsimonious_ECM_fit
```
                  Return an estimated general-to-specific error correction model
```
Summary_ecm_fit
```
                  Return the summary of 'Parsimonious_ECM_fit'

Parsimonious_ECM_diagnostics_test

> Return the diagnostic test for 'Parsimonious_ECM_fit'.The diagnostic tests items
> are the Breusch-Godfrey test for higher-order serial correlation (BG_SC_lm_test).
> The Engle (1982) test for conditional heteroscedasticity (LM_ARCH_test). The
> test for non-normality is that of Jarque and Bera (1980). The RESET null hy-
> pothesis adopted implies - including the 2nd - degree terms improve the fit (over
> the model specified). Ljung and Box (1978) tests for autocorrelation in the resid-
> uals

cointegration   Return the F statistic, the upper and lower critical values for PSS (2001) bounds
> test

Longrun_relation

> The estimated longrun relation from the error correction model

Note

Do not differenced the variables to be adopted in this function and all other functions for ARDL
and NARDL estimation. The package inherently takes the difference and produced output with a
prefix (D.) to the variable name and suffix the variable name with underscore (_) and the lag value.

References

Sucarrat, G. User-Specified General-to-Specific (GETS) and Indicator Saturation (ISAT) Methods.
28th September 2021. https://mirror.epn.edu.ec/CRAN/web/packages/gets/vignettes/user-defined-
gets-and-isat.pdf

See Also

gets gets_nardl_uecm ardl_uecm nardl_auto_case

Examples

```
data("expectation")
out_aut <- auto_case_ardl(x = expectation,
                          dep_var = 'n12m_inf_exp',
                          expl_var = c('food_inf',"hawkish","dovish"),
                          p_order = 2,
                          q_order = c(4,4,4),
                          gets_pval = 0.05,
                          graph_save = FALSE)


data("fuel_price")
out_aut <- auto_case_ardl(x = fuel_price,
                          dep_var = 'fpp',
                          expl_var = c('bdc','wti'),
                          p_order = 2,
                          q_order = c(4,4),
                          gets_pval = 0.08,
                          graph_save = TRUE)
```

---

cumsq *Import from package* **nardl**

Description

The cumsq object is imported from package **nardl**. Help is available here: nardl::cumsq.

---

cusum *Import from package* **nardl**

Description

The cusum object is imported from package **nardl**. Help is available here: nardl::cusum.

---

dynamac_pkg_bounds_test

A function in 'dynamac' package to Perform Pesaran, Shin, and Smith (2001) cointegration test

---

Description

This is an Abridged version of Jordan and Philips (2020). Please, see the dynamac package for the full documentation and due reference be given to the authors of dynamac - Jordan and Philips (2020).

Usage

```
dynamac_pkg_bounds_test(obs, fstat, tstat = NULL, case, k)
```

Arguments

obs	Number of observations
fstat	F-statistics
tstat	't-statistic of the lagged dependent variable'
case	case I to IV
k	'number of regressors appearing in levels in the estimated model, not including the lagged dependent variable'

Value

Fstat	The bounds F statistic, lower and upper bounds
tstat	The bounds t statistic, lower and upper bounds

References

Jordan S, Philips A (2020). _dynamac: Dynamic Simulation and Testing for Single-Equation ARDL Models_. R package version 0.1.11 <https://CRAN.R-project.org/package=dynamac>

See Also

pssbounds

---

expectation   *Inflation Expectation Dataset*

Description

Dataset

Usage

```
data("expectation")
```

Format

A data frame with 47 observations on the following variables.

date date from 2009Q1 to 2020Q4

nq_inf_exp Natural log of Next quarter inflation expectation (index)

n12m_inf_exp Natural log of Next 12-month inflation expectation (index)

hawkish Hawkishness

dovish Dovishness

nethawkish nethawkishness

headline_inf actual headline inflation (percent)

core_inf actual core inflation (percent)

food_inf actual food inflation (percent)

Details

The sentiment indices were extracted (text mined) from CBN monetary policy committee ommuniques with the aid of the monetary policy dictionary adopted in Mate et al. (2021).

Source

....

References

Mate A, Sebok M, Barczikay T (2021) The effect of central bank communication on sovereign bond yields: The case of Hungary. PLoS ONE 16(2): e0245515. https://doi.org/10.1371/journal.pone.0245515

Examples

```
data(expectation)
```

`fuel_price`	*Time series data from 2000M01 through 2021M03*

Description

Time series data on fuel pump price, oil price and exchange rate

Usage

```
data("fuel_price")
```

Format

A data frame with 255 observations on the following variables.

fpp log of Fuel Pump Price Per Litre - Average (PMS)

wti log of West Texas Intemediate

bdc log of Bureau De-change exchange rate (N/$)

date time series from 2000M01 through 2021M03

Source

fpp is obtained from Central Bank of Nigeria 2021Q1 Statistical Bulletin

wti obtained from Wold bank commodity price (pinksheet)

bdc sourced from http://statistics.cbn.gov.ng/cbn-onlinestats/

Examples

```
data(fuel_price)
```

---

gets_ardl_uecm   *General-to-specific approach for the autoregressive distributed lag*
                                  model

Description

Adopt the general-to-specific approach to estimate the autoregressive distributed lag model

Usage

```
gets_ardl_uecm(x, dep_var, expl_var, p_order = c(2), q_order = c(3),
               gets_pval = 0.1, case = 3, F_HC = FALSE, order_l = 5,
               graph_save = FALSE)
```

Arguments

x	data frame
dep_var	A character vector. The dependent variable.
expl_var	Character vector. List of explanatory variable(s)
p_order	Integer. Maximum number of lags for 'dep_var'
q_order	Integer. Maximum number of lags for 'expl_var'
gets_pval	Integer value between 0 and 1 needed for the general-to-specific approach. The default is 0.1 (10 percent significance level). The chosen p-value is the criteria for determining non-significant repressors to be eliminated in a backward elimination path. The final parsimonious model is the best fit model based on the Schwarz information criteria
case	Positive integer 1 to 5. Default is 3
F_HC	Logical (default is FALSE). If TRUE, Heteroscedasticity-Consistent Covariance Matrix Estimation is applied to the model before when estimating F statistic
graph_save	Logical. If TRUE, display stability plot. Default is FALSE
order_l	Integer. order for the serial correlation, and heteroscedasticity test

Value

Parsimonious_ARDL_fit
                  Return an estimated general-to-specific ARDL model
Parsimonious_ECM_fit
                  Return an estimated general-to-specific error correction model
Summary_ecm_fit
                  Return the summary of 'Parsimonious_ECM_fit'
Parsimonious_ECM_diagnostics_test
                  Return the diagnostic test for 'Parsimonious_ECM_fit'.The diagnostic tests items
                  are the Breusch-Godfrey test for higher-order serial correlation (BG_SC_lm_test).
                  The Engle (1982) test for conditional heteroscedasticity (LM_ARCH_test). The

test for non-normality is that of Jarque and Bera (1980). The RESET null hypothesis adopted implies - including the 2nd - degree terms improve the fit (over the model specified). Ljung and Box (1978) tests for autocorrelation in the residuals

cointegration   Return the F statistic, the upper and lower critical values for PSS (2001) bounds test

Longrun_relation

The estimated longrun relation from the error correction model

References

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflations. Econometrica (50) 987 - 1007

Ljung GM, Box GEP (1978). On a Measure of Lack of Fit in Time Series Models. Biometrika, 65(2), 297 - 303. https://doi.org/10.2307/2335207

Jarque C, Bera A (1980). Efficient Tests for Normality, Homoskedasticity, and Serial Independence. Economics Letters, 6(3), 255 - 259. https://doi.org/10.1016/0165-1765 (80) 90024-5

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships Journal of applied econometrics, 16(3), 289-326

See Also

[gets_nardl_uecm](#) [ardl_uecm](#)

Examples

```
data(expectation)
out <- gets_ardl_uecm(x = expectation,
                      dep_var = c('nq_inf_exp'),
                      expl_var = c('food_inf','nethawkish'),
                      p_order = c(4),
                      q_order = c(5,7),
                      gets_pval = 0.1,
                      case = 4,
                      graph_save = FALSE,
                      F_HC = FALSE,
                      order_l = 7)
out
```

---

gets_nardl_uecm   *Parsimonious NARDL model*

Description

Adopt the general-to-specific approach to estimate the autoregressive distributed lag model

Usage

```
gets_nardl_uecm(x, decomp, dep_var, control = NULL, d = Inf, c_q_order = c(2),
                p_order = c(3), q_order = c(4), gets_pval = 0.1, order_l = 4,
                F_HC = FALSE, graph_save = FALSE, case = 3)
```

Arguments

x	data frame
decomp	A character vector. The variable decomposed into positive (pos) and negative (neg) change.
dep_var	A character vector. The dependent variable
control	A character vector. Default is NULL. The second dependent variable.
d	An integer or character vector. The threshold value (d) is adopted when computing the partial sum. The default value Inf is the implicit threshold for the partial sum whenever the base 'cumsum' function is adopted. The value of d can be 'mean' or 0 and any other integer specified as the threshold value for the partial sum.
c_q_order	Integer. Maximum number of lags for 'control'
p_order	Integer. Maximum number of lags for 'dep_var'
q_order	Integer. Maximum number of lags for level and differenced 'decomp'
gets_pval	Integer value between 0 and 1 needed for the general-to-specific approach. The default is 0.1 (10 percent significance level). The chosen p-value is the criteria for determining non-significant repressors to be eliminated in a backward elimination path. The final parsimonious model is the best fit model based on the Schwarz information criteria.
order_l	Integer. order for the serial correlation, and heteroscedasticity test
F_HC	Logical (default is FALSE). If TRUE, heteroscedasticity-Consistent Covariance Matrix Estimation is applied to the model before when estimating F statistic
graph_save	Logical. If TRUE, display stability plot. Default is FALSE.
case	Positive integer 1 to 5. Default is 3

Value

Parsimonious_NARDL_fit

Return an estimated general-to-specific NARDL model.

Parsimonious_ECM_fit

Return an estimated general-to-specific error correction model.

Summary_uecm_fit

Return the summary of 'Parsimonious_ECM_fit'

ecm_diagnostics_test

Return the diagnostic test for the 'Parsimonious_ECM_fit'. The diagnostic tests indicate the Breusch-Godfrey test for higher-order serial correlation (BG_SC_lm_test). The Engle (1982) test for conditional heteroscedasticity (LM_ARCH_test). The test for non-normality is that of Jarque and Bera (1980). The RESET null hypothesis adopted implies - including the 2nd - degree terms improve the fit (over the model specified).

longrun_asym	Return the estimated longrun asymmetric test
Shortrun_asym	Return the estimated short-run asymmetric test.If one of the decomposed variable does not appear among the shortrun differenced variables of the parsimonious model, The value returned is a wald test of whether the sum of the coefficients of the remaining decomposed variable included does not have any significant effect on the best model
cointegration	Return the F statistic, the upper and lower critical values for PSS (2001) bounds test. Please, disregard the tstat on the cointegration test.
Longrun_relation	
	The longrun relation

Note

The decomposed variable should display both positive and negative change, preferably on a balanced scale. However, when a variable display only positive change and no negative change, vice versa, such variable should not be adopted (i.e decomposed).

References

Engle, R. F. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflations. Econometrica 50: 987 - 1007.

Jarque C, Bera A (1980). Efficient Tests for Normality, Homoskedasticity, and Serial Independence. Economics Letters, 6(3), 255 - 259. https://doi.org/10.1016/0165-1765(80) 90024-5.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In: Sickles, R., Horrace, W. (eds) Festschrift in Honor of Peter Schmidt. Springer, New York, NY. https://doi.org/10.1007/978-1-4899-8008-3_9

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

See Also

gets_ardl_uecm ardl_uecm

Examples

```
## Not run:
  data(expectation)
  out <- gets_nardl_uecm(x = expectation,
                         decomp = 'food_inf',
                         dep_var = 'nq_inf_exp',
                         control = 'nethawkish',
                         c_q_order = c(3),
                         p_order = c(3),
                         q_order = c(3),
                         gets_pval = 0.1,
                         graph_save = FALSE,
                         case = 5,
                         F_HC = FALSE)
  out
```

```
## End(Not run)
```

---

lagm   *Lag a matrix*

Description

Take the lag of a variable using the specified number of lag(s).

Usage

```
lagm(x, k)
```

Arguments

x	a matrix object
k	number of lags

Value

x	dimentional matrix with k

Examples

```
x <- cbind(x1 = c(23, 45, 56, 78, 98, 21, 17),
           x2 = c(3, 4, 6, 7, 2, 9, 17))
lagm(x, k = 3)
```

---

nardl_auto_case   *Obtain the best NARDL model specification and bounds test.*

Description

This function finds the best NARDL model specification and conduct bounds test by relying on the general to specific approach.

Usage

```
nardl_auto_case(x, decomp, dep_var, control = NULL, d = Inf, c_q_order = c(2),
                p_order = c(3), q_order, gets_pval = 0.1,
                order_l = order_l, graph_save = FALSE)
```

Arguments

x	Dataframe
decomp	A character vector. The variable to be decomposed to positive (pos) and negative (neg) variable.
dep_var	A character vector. The dependent variable
control	A character vector. Default is NULL. The second dependent variable.
d	An integer or character vector. The threshold value (d) is adopted when computing the partial sum. The default value Inf is the implicit threshold for the partial sum whenever the base 'cumsum' function is adopted. The value of d can be 'mean' or 0 and any other integer specified as the threshold value for the partial sum.
c_q_order	Integer. Maximum number of lags for 'control'
p_order	An integer. Lag differenced adopted for the differenced response variable
q_order	An integer. Lag differenced adopted for the differenced explanatory variable(s)
gets_pval	The p- value which served as criteria for eliminating non-significant variable in the course of obtaining the best model based on the Schwarz information criteria.
order_l	Integer. Needed for the autocorrelation and heteroscedasticity test
graph_save	Logical. If TRUE, displays the stability plots

Details

The procedure of the general-to-specific approach in obtaining the parsimonious model involves conducting the multi-path backwards elimination; tests both single and multiple hypothesis tests, diagnostics tests and goodness-of-fit measures. See page 5 - 6 of Sucarrat (2021) for more details.

The value for gets_pval is influential the final model based on the multipath backward elimination. For more details on the general-to-specific approach, see the vignette of the 'gets' package.

Value

Parsimonious_NARDL_fit

Return an estimated general-to-specific NARDL model.

Parsimonious_ECM_fit

Return an estimated general-to-specific error correction model.

Summary_uecm_fit

Return the summary of 'Parsimonious_ECM_fit'

ecm_diagnostics_test

Return the diagnostic test for the 'Parsimonious_ECM_fit'. The diagnostic tests indicate the Breusch-Godfrey test for higher-order serial correlation (BG_SC_lm_test). The Engle (1982) test for conditional heteroscedasticity (LM_ARCH_test). The test for non-normality is that of Jarque and Bera (1980). The RESET null hypothesis adopted implies - including the 2nd - degree terms improve the fit (over the model specified).

longrun_asym   Return the estimated longrun asymmetric test

Shortrun_asym   Return the estimated short-run asymmetric test.If one of the decomposed vari-
                 able does not appear among the shortrun differenced variables of the parsimo-
                 nious model, The value returned is a wald test of whether the sum of the coeffi-
                 cients of the remaining decomposed variable included does not have any signif-
                 icant effect on the best model

cointegration   Return the F statistic, the upper and lower critical values for PSS (2001) bounds
                 test. Please, disregard the tstat on the cointegration test.

Longrun_relation
                 The longrun relation

Note

Do not differenced the variables to be adopted in this function and all other functions for NARDL
and ARDL estimation. The package inherently takes the difference and produced output with a
prefix (D.) to the variable name and suffix the variable name with underscore (_) and the lag value.

References

Sucarrat, G. User-Specified General-to-Specific (GETS) and Indicator Saturation (ISAT) Methods.
28th September 2021. https://mirror.epn.edu.ec/CRAN/web/packages/gets/vignettes/user-defined-
gets-and-isat.pdf

See Also

gets gets_nardl_uecm ardl_uecm auto_case_ardl

Examples

```
## Not run:
 data("fuel_price")
 out1 <- nardl_auto_case(x = fuel_price,
                decomp =  'wti',
                dep_var = 'fpp',
                control = 'bdc',
                c_q_order = c(5),
                p_order = c(5),
                q_order = c(6),
                gets_pval = 0.1,
                order_l = 4,
                graph_save = FALSE)
 out1

 out2 <- nardl_auto_case(x = fuel_price,
                decomp =  'wti',
                dep_var = 'fpp',
                control = NULL,
                c_q_order = c(4),
                p_order = c(5),
                q_order = c(6),
                gets_pval = 0.02,
                order_l = 4,
```

```
                     graph_save = FALSE)
   out2

## End(Not run)
```

---

nardl_mdv *A NARDL model with two decomposed variables*

Description

Estimate a NARDL model, having mulitple (two) decomposed variables

Usage

```
nardl_mdv(x, dep_var, decomp1, decomp2, thresh1 = Inf, thresh2 = Inf,
gets = TRUE, gets_pval = 0.1, case = NULL, conservative = FALSE, p_order = c(3),
q_order1 = c(5), q_order2 = c(5), order_l = 4, graph_save = FALSE)
```

Arguments

x	A dataframe
dep_var	The dependent variable
decomp1	Initial variable to be decomposed into postive and negative.
decomp2	The second variable decomposed into postive and negative.
thresh1	An integer or character vector. The threshold value (thresh1) for the first variable is adopted when computing the partial sum. Inf is the implicit threshold value for the partial sum whenever the base 'cumsum' function is adopted. The value of the threshold can be 'mean' or 0 or any other integer stated for the partial sum.
thresh2	An integer or character vector. The threshold value (thresh2) for the second decomposed variable.
gets	Logical. General-to-specific (GETS) approach. Default is TRUE which indicate adopting the GETS
gets_pval	The p-value adopted when gets is set as TRUE
case	An integer which can take either of 1, 2, 3, 4 or 5. The assumption on Bounds test procedure. Default is NULL. When it is set as an integer, gets should be set as FALSE.
conservative	Logical. Default is FALSE. When TRUE, the decomposed variables are assumed to be $k = 2$. When FALSE, $k = 4$.
p_order	An integer. Take the number of lags applicable to the dependent variable
q_order1	An integer. Take maximum number of lags applicable to the first variable
q_order2	An integer. The maximum number of lags applicable to the second variable
order_l	An integer. Used in the diagnostics test
graph_save	Logical. Default is FALSE. When TRUE, return the stability plots of the model

Details

Return a list containing

Value

NARDL_fit   NARDL model

ECM_fit   NARDL-ECM

Summary_uecm_fit

               Summary of ECM_fit

ecm_diagnostics_test

               Diagnostic tests

longrun_asym   longrun asymmetric test

Shortrun_asym   Shortrun asymmetric test

cointegration   PSS bounds test

Longrun_relation

               Longrun relationship

Note

The decomposed variable should display both positive and negative change, preferably on a balanced scale. However, when a variable display only positive change and no negative change, vice versa, such variable should not be adopted (i.e decomposed).

References

Jordan S, Philips A (2020). _dynamac: Dynamic Simulation and Testing for Single-Equation ARDL Models_. R package version 0.1.11

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. Applied economics, 37(17), 1979-1990.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In: Sickles, R., Horrace, W. (eds) Festschrift in Honor of Peter Schmidt. Springer, New York, NY. https://doi.org/10.1007/978-1-4899-8008-3_9

Zaghdoudi, T. (2018). nardl: Nonlinear Cointegrating Autoregressive Distributed Lag Model_. R package version 0.1.5

See Also

[nardl_uecm](#)

Examples

```
## Not run:
data(expectation)
nardl_mdv(x = expectation,
          dep_var = 'nq_inf_exp',
          decomp1 = 'food_inf',
          decomp2 = 'nethawkish',
          p_order = c(7),
          q_order1 = c(4),
          q_order2 = c(6),
          gets_pval = 0.1,
          conservative = FALSE,
          gets = FALSE,
          case = 5,
          order_l = 3,
          graph_save = FALSE)

## End(Not run)
```

---

nardl_uecm   *Estimate the nonlinear ARDL (NARDL) Error Correction Model*

Description

Function to estimate Shin, Yu, and Greenwood-Nimmo (2014) nonlinear ARDL (NARDL), the NARDL ECM, and conduct the bounds test for cointegration.

Usage

```
nardl_uecm(x, decomp, d = Inf, control = NULL, c_q_order = c(2),
p_order = c(3), q_order = c(4), dep_var, order_l = 4, graph_save = FALSE, case = 3)
```

Arguments

x	A dataframe object. S3 dataframe object not applicable.
decomp	A character vector. The variable to be decomposed into positive (pos) and negative (neg) change.
d	An integer or character vector. The default value Inf for the threshold value (d) is adopted when computing the partial sum. Inf is the implicit threshold for the partial sum whenever the base 'cumsum' function is adopted. The value of d can be 'mean' or 0 and any other integer specified as the threshold value for the partial sum.
control	A character vector with one element serving as the second variable in the right hand side of the equation. The default is NULL.
c_q_order	Lag order for 'control'. the default value is c(2) and only applicable when control is specified.
p_order	Positive interger. Number of lags for dependent variable (dep_var).

q_order	Positive interger. Short-run lags for the decomposed variables. In case the LM test null hypothesis of no serial correlation is rejected, consider increasing the lags, in particular, the p_order or both p_order and q_order lags until the null hypothesis is accepted.
dep_var	Character vector. The dependent variable.
order_l	Positive integer. lag order for the serial correlation, and heteroscedasticity test
graph_save	Logical (default is FALSE). If TRUE, stability plot is displayed.
case	A numerical vector that can take a value between 1 to 5. The default value is case 3. See details for more information.

Value

NARDL_fit	This display the NARDL lm fit
NARDL_ECM_fit	This display the NARDL ECM lm fit
UECM	This display the summary results of the estimated unrestricted error correction models
cointegration	This presents the Pesaran, Shin, and Smith (2001) cointegration test. The critical F and t statistics obtained if the sample is greater than 80 are asymptotic. If you adopt this segment, please consider citing Pesaran et al (2001) and Jordan and Philips (2020) dynamac package. If the sample is less than or equal to 80, for case 1, the F and t statistics adopted are large sample asymptotic critical value (CV) and no small-sample asymptotic critical value available. When case = 3 or 5, the critical value of F statistic is small sample asymptotic, and the adopted t statistics are large sample asymptotic CV. Consider including Narayan (2005) in your citation list. If the sample is greater than 80, for case 1, 3 and 5, large sample asymptotic CV for F and t statistics are adopted. In case 2 and 4, for sample <= 80, the F statistic are small sample asymptotic and no asymptotic CV for the t statistic. If sample > 80, for case 2 and 4, large sample asymptotic CV for F is adopted and no t-statistic CV.

Longrun_relation

The estimated longrun relations

Longrun_asymmetric_test

This contains the asymmetric test, with the null hypothesis of longrun coefficients of the positive decomposed variable equals to the coefficient of negative decomposed variable.

Shortrun_asymmetric_test

This contains the asymmetric test, with the null hypothesis the sum of the coefficients of all the short run positive decomposed variable equals to the sum of the coefficients of the short-run negative decomposed variable.

diagnostics test

The diagnostic tests indicate the Breusch-Godfrey test for higher-order serial correlation (BG_SC_lm_test). The Engle (1982) test for conditional heteroscedasticity (LM_ARCH_test). The test for non-normality is that of Jarque and Bera (1980). The RESET null hypothesis adopted implies - including the 2nd - degree terms improve the fit (over the model specified). This ARCH LM function is derived from Zaghdoudi (2018)

Note

The decomposed variable should display both positive and negative trend, preferably on a balanced scale. However, when a variable display only positive change and no negative change, vice versa, such variable should not be adopted (i.e decomposed).

References

Jordan S, Philips A (2020). _dynamac: Dynamic Simulation and Testing for Single-Equation ARDL Models_. R package version 0.1.11

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. Applied economics, 37(17), 1979-1990.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In: Sickles, R., Horrace, W. (eds) Festschrift in Honor of Peter Schmidt. Springer, New York, NY. https://doi.org/10.1007/978-1-4899-8008-3_9

Zaghdoudi, T. (2018). nardl: Nonlinear Cointegrating Autoregressive Distributed Lag Model_. R package version 0.1.5

See Also

ardl_uecm nardl_uecm_sym

Examples

```
data(fuel_price)
output_n1_case5 <- nardl_uecm(x = fuel_price,
                              decomp  = c('bdc'),
                              control =c('wti'),
                              c_q_order = c(2),
                              p_order = c(3),
                              q_order = c(5),
                              dep_var = c('fpp'),
                              graph_save = FALSE,
                              case = 5)
output_n1_case5
output_n1_case5$UECM

output_n2_case3 <- nardl_uecm(x = fuel_price,
                              decomp  = c('bdc'),
                              control =NULL,
                              c_q_order = NULL,
                              p_order = c(3),
                              q_order = c(5),
                              dep_var = c('fpp'),
                              graph_save = FALSE,
                              case = 3)
output_n2_case3
```

---

nardl_uecm_sym   *Short-run symmetry restrictions (SRSR) and the longrun symmetry restrictions (LRSR).*

Description

~~ Performs one of Short-run symmetry restrictions or the longrun symmetry restrictions.

Usage

```
nardl_uecm_sym(x, assumption = c("SRSR"), decomp, d = Inf, control = c(2),
c_q_order = c(2), p_order = c(3), q_order = c(4), dep_var, graph_save = FALSE, case = 3)
```

Arguments

x	A dataframe object. S3 dataframe object not applicable.
assumption	The Short-run symmetry restrictions (SRSR), the default, assume the transitory asymmetric effect is insignificant and testing the longrun asymmetric effect. longrun symmetry restrictions (LRSR) imposes symmetric effect on the longrun coefficients of the positive and negative decomposed variable, and assuming the presence of transitory asymmetric effect.
decomp	A variable to be decomposed into positive (pos) and negative (neg)
d	An integer or character vector. The default value Inf for the threshold value (d) is adopted when computing the partial sum. Inf is the implicit threshold for the partial sum whenever the base 'cumsum' function is adopted. The value of d can be 'mean' or 0 and any other integer specified as the threshold value for the partial sum.
control	A character vector with one element serving as the second variable single control variable. The default is c(2) and applicable when control variable is specified.
c_q_order	Lag order for the control. The default value is c(2) and only applicable when control is specified.
p_order	Number of lags for dependent variable (dep_var).
q_order	Short-run lags for each positive and negative decomposed variable. In case the LM test null hypothesis of no serial correlation is rejected, consider increasing the lags, in particular, the p_order or both p_order and q_order lags until the null hypothesis is accepted.
dep_var	Character vector which contain the dependent variable.
graph_save	Logical (default is FALSE). If TRUE, stability plot is displayed.
case	A numerical vector of either 1, 2 3, 4 or 5. The default value is 3. See details for more information.

Details

The Short-run symmetry restrictions (SRSR), the default may be useful in obtaining more accurate estimate when the sample is small (SYG, 2014). Besides, this may be necessary when the short-run asymmetric effect does not exist. longrun symmetry restrictions (LRSR) imposes symmetric effect on the positive and negative decomposed variable.

Value

NARDL_ECM_fit   This display the NARDL ECM lm fit

UECM   This display the summary results of the estimated unrestricted error correction models

cointegration   This presents the Pesaran, Shin, and Smith (2001) cointegration test. The critical F and t statistics obtained if the sample is greater than 80 are asymptotic. If you adopt this segment, please consider citing Pesaran et al (2001) and Jordan and Philips (2020) dynamac package. If the sample is less than or equal to 80, for case 1, the F and t statistics adopted are large sample asymptotic critical value (CV) and no small-sample asymptotic critical value available. When case = 3 or 5, the critical value of F statistic is small sample asymptotic, and the adopted t statistics are large sample asymptotic CV. Consider including Narayan (2005) in your citation list. If the sample is greater than 80, for case 1, 3 and 5, large sample asymptotic CV for F and t statistics are adopted. In case 2 and 4, for sample <= 80, the F statistic are small sample asymptotic and no asymptotic CV for the t statistic. If sample > 80, for case 2 and 4, large sample asymptotic CV for F is adopted and no t-statistic CV.

Longrun_relation

                The estimated longrun relations

asymmetric test

                This contains the asymmetric test

diagnostics test

                This presents the Breusch-Godfrey test for higher-order serial correlation with null hypothesis of no serial correlation, the Autoregressive Conditional Heteroscedasticity (ARCH) LM-test with the null hypothesis of no ARCH effect and the Jarque-Bera normality test with null hypothesis of normality. This ARCH LM function is derived from Zaghdoudi (2018)

Note

The decomposed variable should display both positive and negative change, preferably on a balanced scale. However, when a variable display only positive change and no negative change, vice versa, such variable should not be adopted (i.e decomposed).

References

Jordan S, Philips A (2020). _dynamac: Dynamic Simulation and Testing for Single-Equation ARDL Models_. R package version 0.1.11

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. Applied economics, 37(17), 1979-1990.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics, 16(3), 289-326.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In: Sickles, R., Horrace, W. (eds) Festschrift in Honor of Peter Schmidt. Springer, New York, NY. https://doi.org/10.1007/978-1-4899-8008-3_9

Zaghdoudi, T. (2018). nardl: Nonlinear Cointegrating Autoregressive Distributed Lag Model_. R package version 0.1.5

See Also

[ardl_uecm](#) [nardl_uecm](#) [pssbounds](#)

Examples

```
data(syg_data)
out_srsr <- nardl_uecm_sym(x = syg_data,
             decomp  = 'ca_ip',
             assumption = c('SRSR'),
             control =NULL,
             p_order =5,
             q_order =3,
             dep_var = 'ca_u',
             graph_save = FALSE,
             case = 3)
out_srsr

out_lrsr <- nardl_uecm_sym(x = syg_data,
                           decomp  = 'ca_ip',
                           assumption = c('LRSR'),
                           control =NULL,
                           p_order =5,
                           q_order =3,
                           dep_var = 'ca_u',
                           graph_save = FALSE,
                           case = 3)
out_lrsr
```

---

output_ren   *Rename the coefficient of the nardl_uecm summary output*

Description

As the case might be, their could be need to rename the rownames in nardl_uecm summary output

Usage

```
output_ren(x, listn = listn, D.patern, D.repl, l.patern, l.repl)
```

Arguments

x	A summary model output, preferably, nardl_uecm object
listn	A character vector
D.patern	The difference and lag difference variables contained the model
D.repl	Character vector containing the new names to replace the D.patern
l.patern	Character vector of variable appearing at level
l.repl	Character vector containing the names to replace l.patern

Value

x	nardl_uecm or nardl_uecm_sym object

Examples

```
data(syg_data)
un <- c('ca_u','jp_u','us_u')
ip <- c('ca_ip','jp_ip','us_ip')
cnames <- c('Canada','Japan','United States')
case <- c(5,5,5)
p_lags <- c(3,4,5)
q_lags <- c(3,4,5)
#######################################
out_nardl <- lapply(1:length(un), function(i)
  nardl_uecm(x = syg_data,
             decomp  = un[[i]],
             control =NULL,
             c_q_order = c(2),
             p_order =p_lags[[i]],
             q_order =q_lags[[i]],
             dep_var = ip[[i]],
             graph_save = FALSE,
             case = 3))
names(out_nardl) <- cnames
out_nardl$Canada$UECM

output <- output_ren(x=out_nardl,listn = un,
          D.patern="D.ca_ip|D.jp_ip|D.us_ip",D.repl="D.output",
          l.patern ="ca_ip|jp_ip|us_ip",l.repl="output")

output <- output_ren(x=output,listn = un,
            D.patern="D.ca_u|D.jp_u|D.us_u",D.repl="D.unemployment",
            l.patern ="ca_u|jp_u|us_u",l.repl="unemployment")

output$Canada$UECM
```

---

ssa	*data on health expenditure, per capita income and life expectancy in Sub-Saharan countries*

Description

panel data on

Usage

```
data("ssa")
```

Format

A panel data frame on the following variables.

id list of SSA countries

year year

HEP health expenditure per capital

PCI Per capita income

LE Life expectancy

Note

variables are in natural log

Source

WDI WHO

---

syg_data	*Time series data on output and unemployment in Canada, Japan and United States from 1981M01 to 2022M07*

Description

Data on unemployment and industrial production for Canada, Japan and United States

Usage

```
data("syg_data")
```

Format

A data frame with 0 observations on the following variables.

ca_u Canada (CA) unemployment rate

jp_u Japan (JP) unemployment rate

us_u United States (US) unemployment rate

us_ip Natural log of US industrial production (s.a)

jp_ip Natural log of JP industrial production (s.a)

ca_ip Natural log of CA industrial production (s.a)

time 1981M01 - 2022M07

Details

_U is Unemployment rate (monthly), Total, All persons _IP is index of industrial production, s.a.

Source

https://stats.oecd.org/index.aspx?lang=en

Examples

data(syg_data)

Index