Package 'mvardlurt'

May 9, 2026

Type Package

Title Multivariate ARDL Unit Root Test

Version 1.0.2

Description Implements the multivariate autoregressive distributed lag (ARDL) unit root test proposed by Sam, McNown, Goh, and Goh (2024) <doi:10.1080/03796205.2024.2439101>. The test augments the standard ADF regression with lagged levels of a covariate to improve power when cointegration exists. Bootstrap critical values ensure correct size regardless of nuisance parameters. Provides automatic lag selection via AIC/BIC, diagnostic tests, and comprehensive inference tables following the four-case framework.

License GPL-3

URL https://github.com/muhammedalkhalaf/mvardlurt

BugReports https://github.com/muhammedalkhalaf/mvardlurt/issues

Encoding UTF-8

RoxygenNote 7.3.2

Depends R (>= 4.0.0)

Imports grDevices, graphics, stats, utils

Suggests testthat (>= 3.0.0), knitr, rmarkdown

Config/testthat/edition 3

NeedsCompilation no

Author Muhammad Alkhalaf [aut, cre, cph] (ORCID: <https://orcid.org/0009-0002-2677-9246>)

Maintainer Muhammad Alkhalaf <muhammedalkhalaf@gmail.com>

Repository CRAN

Date/Publication 2026-03-16 15:50:10 UTC

Contents

`mvardlurt-package` *Multivariate ARDL Unit Root Test*

Description

Implements the multivariate autoregressive distributed lag (ARDL) unit root test proposed by Sam, McNown, Goh, and Goh (2024). The test augments the standard ADF regression with lagged levels of a covariate to improve power when cointegration exists. Bootstrap critical values ensure correct size regardless of nuisance parameters.

Details

The main function is `mvardlurt`, which performs the multivariate ARDL unit root test. The package provides:

- Automatic lag selection via AIC or BIC
- Bootstrap critical values for correct test size
- Three deterministic specifications (none, intercept, intercept + trend)
- Four-case decision framework for inference
- Comprehensive print and summary output
- Diagnostic plots

The test produces two statistics:

- **t-statistic**: Tests $H_0 : \pi = 0$ (unit root)
- **F-statistic**: Tests $H_0 : \delta = 0$ (no cointegration)

The four-case framework interprets results as:

- Case I: Both reject $\rightarrow$ Cointegration
- Case II: Reject t, Accept F $\rightarrow$ y may be I(0)
- Case III: Accept t, Reject F $\rightarrow$ Spurious
- Case IV: Both accept $\rightarrow$ No cointegration

Author(s)

Muhammad Alkhalaf

References

Sam, C. Y., McNown, R., Goh, S. K., & Goh, K. L. (2024). A multivariate autoregressive distributed lag unit root test. *Studies in Economics and Econometrics*, 1-17. doi:10.1080/03796205.2024.2439101

See Also

mvardlurt

Examples

```
# Generate cointegrated data
set.seed(123)
n <- 200
x <- cumsum(rnorm(n))
y <- 0.5 * x + rnorm(n, sd = 0.5)

# Run the test
result <- mvardlurt(y, x, case = 3, reps = 200)
print(result)
```

---

autoplot.mvardlurt *Create a Combined Diagnostic Plot for mvardlurt Objects*

Description

Creates a 2x2 panel of diagnostic plots for the multivariate ARDL unit root test including residuals vs fitted, Q-Q plot, residuals over time, and ACF.

Usage

```
## S3 method for class 'mvardlurt'
autoplot(x, ...)
```

Arguments

x	An object of class "mvardlurt".
...	Additional arguments passed to plotting functions.

Value

Invisibly returns x.

Author(s)

Muhammad Alkhalaf

See Also

mvardlurt, plot.mvardlurt

Examples

```
set.seed(123)
n <- 100
x <- cumsum(rnorm(n))
y <- 0.5 * x + rnorm(n, sd = 0.5)

result <- mvardlurt(y, x, reps = 100)
autoplot.mvardlurt(result)
```

`mvardlurt` *Multivariate ARDL Unit Root Test*

Description

Implements the multivariate autoregressive distributed lag (ARDL) unit root test proposed by Sam, McNown, Goh, and Goh (2024). The test augments the standard ADF regression with lagged levels of a covariate (independent variable) to improve power, especially when cointegration exists. Bootstrap critical values ensure correct size regardless of nuisance parameters.

Usage

```
mvardlurt(y, x, case = 3L, maxlag = 10L, ic = "aic",
          fixlag = NULL, reps = 1000L, level = 0.95,
          seed = 12345L, boot = TRUE)
```

Arguments

`y`	A numeric vector or time series. The dependent variable.
`x`	A numeric vector or time series. The independent variable (covariate).
`case`	Integer. Deterministic specification: • `1`: No deterministic terms • `3`: Intercept only (default) • `5`: Intercept and linear trend
`maxlag`	Integer. Maximum lag order for AIC/BIC selection. Default is 10. Must be between 0 and 10.
`ic`	Character. Information criterion for lag selection: `"aic"` (default) or `"bic"`.
`fixlag`	Optional numeric vector of length 2, specifying fixed lag orders `c(p, q)` for Δy and Δx respectively. If provided, overrides automatic lag selection.
`reps`	Integer. Number of bootstrap replications. Default is 1000. Minimum is 100.
`level`	Numeric. Confidence level for inference (0 to 1). Default is 0.95.
`seed`	Integer. Random seed for reproducibility. Default is 12345.
`boot`	Logical. Whether to compute bootstrap critical values. Default is `TRUE`.

Details

The test estimates the following ARDL regression:

$$\Delta y_t = \pi y_{t-1} + \delta x_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta y_{t-j} + \sum_{j=1}^{q} \theta_j \Delta x_{t-j} + deterministics + \varepsilon_t$$

The test produces two statistics:

- **t-statistic**: Tests $H_0 : \pi = 0$ (unit root in y)
- **F-statistic**: Tests $H_0 : \delta = 0$ (no cointegration)

Based on the four-case framework (Sam et al., 2024):

- **Case I**: Reject both → Cointegration
- **Case II**: Reject t, Accept F → Degenerate case 1 (y may be I(0))
- **Case III**: Accept t, Reject F → Degenerate case 2 (spurious)
- **Case IV**: Accept both → No cointegration

Value

An object of class `"mvardlurt"` containing:

`tstat`	t-statistic for the unit root test (on π)
`fstat`	F-statistic for the cointegration test (on δ)
`fstat_p`	Asymptotic p-value for the F-statistic
`pi_coef`	Coefficient estimate of π (lagged y)
`pi_se`	Standard error of π
`delta_coef`	Coefficient estimate of δ (lagged x)
`delta_se`	Standard error of δ
`lr_mult`	Long-run multiplier $-\delta/\pi$ (if $\pi \neq 0$)
`opt_p`	Selected lag order for Δy
`opt_q`	Selected lag order for Δx
`case`	Deterministic case used
`casename`	Description of the deterministic case
`reps`	Number of bootstrap replications
`nobs`	Number of observations used
`aic`	AIC value of the selected model
`bic`	BIC value of the selected model
`r_squared`	R-squared of the regression
`t_cv`	Bootstrap critical values for t-statistic (10%, 5%, 2.5%, 1%)
`f_cv`	Bootstrap critical values for F-statistic (10%, 5%, 2.5%, 1%)
`ic_table`	Matrix of IC values for all (p, q) combinations

`decision`	List containing test decisions and significance levels
`model`	The fitted `lm` object
`y`	Original dependent variable
`x`	Original independent variable
`residuals`	Residuals from the fitted model

Author(s)

Muhammad Alkhalaf

References

Sam, C. Y., McNown, R., Goh, S. K., & Goh, K. L. (2024). A multivariate autoregressive distributed lag unit root test. *Studies in Economics and Econometrics*, 1-17. doi:10.1080/03796205.2024.2439101

Examples

```
# Generate example data with cointegration
set.seed(123)
n <- 200
x <- cumsum(rnorm(n))
y <- 0.5 * x + rnorm(n, sd = 0.5)

# Run the test (reduced reps for speed)
result <- mvardlurt(y, x, case = 3, reps = 200)
print(result)

# With fixed lags
result2 <- mvardlurt(y, x, fixlag = c(2, 2), reps = 200)
```

`plot.mvardlurt` *Plot Method for mvardlurt Objects*

Description

Creates diagnostic plots for the multivariate ARDL unit root test.

Usage

```
## S3 method for class 'mvardlurt'
plot(x, which = c(1, 2, 3, 4),
     ask = (length(which) > 1 && dev.interactive()), ...)
```

Arguments

x	An object of class "mvardlurt".
which	Integer vector indicating which plots to produce: • 1: Residuals vs Fitted • 2: Q-Q plot of residuals • 3: Residuals over time • 4: ACF of residuals • 5: Time series of y and x • 6: Information criterion surface Default is c(1, 2, 3, 4).
ask	Logical. If TRUE, prompt before each plot. Default is TRUE when multiple plots are requested in an interactive session.
...	Additional arguments passed to plotting functions.

Value

Invisibly returns x.

Author(s)

Muhammad Alkhalaf

See Also

mvardlurt, autoplot.mvardlurt

Examples

```
set.seed(123)
n <- 100
x <- cumsum(rnorm(n))
y <- 0.5 * x + rnorm(n, sd = 0.5)

result <- mvardlurt(y, x, reps = 100)

# Default diagnostic plots
plot(result, ask = FALSE)

# IC surface plot
plot(result, which = 6)
```

`print.mvardlurt` *Methods for mvardlurt Objects*

Description

Print, summary, and accessor methods for objects of class `"mvardlurt"`.

Usage

```
## S3 method for class 'mvardlurt'
print(x, ...)

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

## S3 method for class 'mvardlurt'
coef(object, ...)

## S3 method for class 'mvardlurt'
residuals(object, ...)

## S3 method for class 'mvardlurt'
fitted(object, ...)
```

Arguments

`x`	An object of class `"mvardlurt"`.
`object`	An object of class `"mvardlurt"`.
`...`	Additional arguments (ignored).

Value

`print` and `summary` invisibly return `x`/`object`.

`coef` returns a named numeric vector with `pi`, `delta`, and `lr_mult`.

`residuals` returns the numeric vector of residuals from the fitted model.

`fitted` returns the numeric vector of fitted values.

Author(s)

Muhammad Alkhalaf

See Also

`mvardlurt`

Examples

```
set.seed(123)
n <- 100
x <- cumsum(rnorm(n))
y <- 0.5 * x + rnorm(n, sd = 0.5)

result <- mvardlurt(y, x, reps = 100)

# Print method
print(result)

# Summary method
summary(result)

# Extract coefficients
coef(result)

# Extract residuals
head(residuals(result))

# Extract fitted values
head(fitted(result))
```

Index