Package 'IndGenErrors'

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Type Package

Title Tests of Independence Between Innovations of Generalized Error Models

Version 0.1.6

Description Computation of test statistics of independence between (continuous) innovations of time series. They can be used with stochastic volatility models and Hidden Markov Models (HMM). This improves the results in Duchesne, Ghoudi & Remillard (2012) <doi:10.1002/cjs.11141>.

Depends R (>= 3.5.0), stats

Imports ggplot2, MixedIndTests

License GPL (>= 2)

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Contents

`CrossCorrelogram` *Cross-correlogram*

Description

This function, used in crosscor_2series and crosscor_3series plots the graphs of the cross-correlation statistics.

Usage

```
CrossCorrelogram(object, comb, rot = 0)
```

Arguments

`object`	List of the output (statistics, pvalues) from crosscor_2series and crosscor_3series
`comb`	Name (string) of series, e.g., comb="(x,y)"
`rot`	Rotation of labels (default=0)

Value

`Output`	No values are returned; only the graph is printed

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Examples

```
 #Romano-Siegel's example #
data(romano_ex)
outr = crosscor_3series(romano_ex$x,romano_ex$y,romano_ex$z,5,2)
CrossCorrelogram(outr$out123,"{x,y,z}",rot=90)
```

`crosscor_2series` *Cross-correlations for testing independence between the innovations of 2 series of same length*

Description

This function computes the cross-correlations between x(t) and y(t-l), for l=-lag,.., lag, and also the combination (Wald's type) of these statistics.

Usage

```
crosscor_2series(x, y, lag, graph = TRUE)
```

Arguments

`x`	Pseudo-observations (or residuals) of first series
`y`	Pseudo-observations (or residuals) of second series
`lag`	Maximum number of lags around 0
`graph`	Set to TRUE for a correlogram for all possible lags.

Value

`stat`	Cross-correlations for all lags
`LB`	Sum of squares of cross-correlations
`pvalue`	P-value of LB
`subsets`	c(-lag:lag)
`n`	length of the time series

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Examples

```
data(gas)
outr <-crosscor_2series(gas$xres,gas$yres,3)
```

`crosscor_3series` *Cross-correlations statistics for testing independence between the innovations of 3 series of same length*

Description

This function computes the cross-correlations for all lags = -lag2, .. lag2, for all pairs, and for pair of lags = (-lag3,-lag3),...(lag3,lag3) for the three series.

Usage

```
crosscor_3series(x, y, z, lag2, lag3)
```

Arguments

`x`	Pseudo-observations (or residuals) of first series.
`y`	Pseudo-observations (or residuals) of second series.
`z`	Pseudo-observations (or residuals) of third series.
`lag2`	Maximum number of lags around 0 for pairs of series.
`lag3`	Maximum number of lags around 0 for the three series.

Value

`stat`	Cross-correlations for all lags and for all subsets
`H`	Sum of squares of cross-correlations for all subsets
`pvalue`	P-value of stat for all subsets and H
`n`	length of the time series

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Examples

```
# Romano-Siegel's example #
data(romano_ex)
outr = crosscor_3series(romano_ex$x,romano_ex$y,romano_ex$z,5,2)
```

`crossdep_2series` *Cross-dependences for testing independence between the innovations of 2 series of same length*

Description

This function computes the cross-dependence between x(t) and y(t-l), for Spearman, van der Waerden and Savage dependence measures, for l=-lag,.., lag, and also the combination (Wald's type) of these statistics.

Usage

```
crossdep_2series(x, y, lag, graph = TRUE)
```

Arguments

`x`	Pseudo-observations (or residuals) of first series
`y`	Pseudo-observations (or residuals) of second series
`lag`	Maximum number of lags around 0
`graph`	Set to TRUE for a correlogram for all possible lags.

Value

`stat`	Cross-dependences for all lags
`H`	Sum of squares of cross-dependences
`pvalue`	P-value of H
`subsets`	c(-lag:lag)
`n`	length of the time series

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Nasri & Remillard (2024). Tests of independence and randomness for arbitrary data using copula-based covariances. JMVA, vol. 201, 105273.

Examples

```
data(gas)
outr <-crossdep_2series(gas$xres,gas$yres,3)
```

`crossdep_3series` *Cross-dependence statistics for testing independence between the innovations of 3 series of same length*

Description

This function computes the cross-dependence for Spearman, van der Waerden and Savage dependence measures, for all lags = -lag2, .. lag2, for all pairs, and for pair of lags = (-lag3,-lag3),...(lag3,lag3) for the three series.

Usage

```
crossdep_3series(x, y, z, lag2, lag3)
```

Arguments

`x`	Pseudo-observations (or residuals) of first series.
`y`	Pseudo-observations (or residuals) of second series.
`z`	Pseudo-observations (or residuals) of third series.
`lag2`	Maximum number of lags around 0 for pairs of series.
`lag3`	Maximum number of lags around 0 for the three series.

Value

`stat`	Cross-dependences for all lags and for all subsets
`H`	Sum of squares of cross-correlations for all subsets
`pvalue`	P-value of LB for all subsets and H
`n`	length of the time series

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Nasri & Remillard (2024). Tests of independence and randomness for arbitrary data using copula-based covariances. JMVA, vol. 201, 105273.

Examples

```
#Romano-Siegel's example #
data(romano_ex)
outr = crossdep_3series(romano_ex$x,romano_ex$y,romano_ex$z,5,2)
CrossCorrelogram(outr$spearman$out123,"Savage for {1,2,3}",rot=90)
```

`cvm_2series` *Cramer-von Mises Moebius statistics for testing independence between the innovations of 2 series of same length*

Description

This function computes the Cramer-von Mises statistics between x(t) and y(t-l), for l=-lag,.., lag, and also the combinations of the p-values of these statistics.

Usage

```
cvm_2series(x, y, lag, graph = TRUE)
```

Arguments

`x`	Pseudo-observations (or residuals) of first series
`y`	Pseudo-observations (or residuals) of second series
`lag`	Maximum number of lags around 0
`graph`	Set to TRUE for a dependogram for all possible lags.

Value

`cvm`	Cramer-von Mises statistics for all lags
`Wstat`	Sum of (unbiased) Cramer-von Mises statistics
`Fstat`	Combination of p-values of the Cramer-von Mises statistics
`pvalue`	List of p-values for the cvm, Wstat, and Fstat

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Examples

```
data(gas)
out <-cvm_2series(gas$xres,gas$yres,3)
```

`cvm_3series` *Cramer-von Mises Moebius statistics for testing independence between the innovations of 3 series of same length*

Description

This function computes the Cramer-von Mises statistics between x(t), y(t-l2), z(t-l3), for l2=-lag2,.., lag2, l3=-lag3,.., lag3,and also the combinations of these statistics.

Usage

```
cvm_3series(x, y, z, lag2, lag3)
```

Arguments

`x`	Pseudo-observations (or residuals) of first series.
`y`	Pseudo-observations (or residuals) of second series.
`z`	Pseudo-observations (or residuals) of third series.
`lag2`	Maximum number of lags around 0 for pairs of series.
`lag3`	Maximum number of lags around 0 for the three series.

Value

`cvm`	Cramer-von Mises statistics for all lags and for all subsets
`Wstat`	Sum of (unbiased) Cramer-von Mises statistics for all subsets
`Fstat`	Combination of p-values of the Cramer-von Mises statistics
`pvalue`	List of p-values for the cvm, Wstat, and Fstat

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Examples

```
set.seed(1)
x0 = rnorm(100); y = rnorm(100); z = rnorm(100);
```

dependogram *Dependogram for Cramer-von Mises statistics*

Description

This function, used in cvm_2series and cvm_3series draws the P-values of the Moebius Cramer-von Mises statistics.

Usage

```
dependogram(object, stat, rot = 0)
```

Arguments

object	List of the output (statistics, pvalues) from cvm_2series and cvmr_3series
stat	Name (string) of statistics to be used
rot	Rotation of labels (default=0)

Value

Output	No values are returned; only the graph is printed

References

Duchesne, Ghoudi & Remillard (2012). On Testing for independence between the innovations of several time series. CJS, vol. 40, 447-479.

Examples

```
#Romano-Siegel's example #
data(romano_ex)
out = cvm_3series(romano_ex$x,romano_ex$y,romano_ex$z,5,2)
dependogram(out$out123,"{x,y,z}",rot=90)
```

gas *Standardized residuals of weekly log-returns of gas and oil prices in Canada from 2008 to end of February 2011*

Description

Data frame containg xres (standardized residuals of gas prices from a ARMA(2,2) model) and yres (standardized residuals of oil prices from a ARMA(1,1)-GARCH(1,1) model).

Usage

```
data(gas)
```

Format

Residuals

Examples

```
data(gas)
plot(gas$xres)
```

---

romano_ex *Simulated values of a Romano & Siegel example*

Description

Data frame containing 100 values of x,y,z generated as follows: x0 = rnorm(100); y = rnorm(100); z = rnorm(100); x = abs(x0)*sign(y*z). All pairs are independent but the three series are not.

Usage

```
data(romano_ex)
```

Format

dataframe

Examples

```
data(romano_ex)
plot(romano_ex$x)
```

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