Package 'W2CWM2C'

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Title A Graphical Tool for Wavelet (Cross) Correlation and Wavelet Multiple (Cross) Correlation Analysis

Description Set of functions that improves the graphical presentations of the functions: wave.correlation and spin.correlation (waveslim package, Whitcher 2012) and the wave.multiple.correlation and wave.multiple.cross.correlation (wavemulcor package, Fernandez-Macho 2012b). The plot outputs (heatmaps) can be displayed in the screen or can be saved as PNG or JPG images or as PDF or EPS formats. The W2CWM2C package also helps to handle the (input data) multivariate time series easily as a list of N elements (times series) and provides a multivariate data set (dataexample) to exemplify its use. A description of the package was published in a scientific paper: Polanco-Martinez and Fernandez-Macho (2014), <doi:10.1109/MCSE.2014.96>.

Depends R (>= 2.14.1), waveslim, wavemulcor, colorspace

URL https://github.com/jomopo/W2CWM2C

Author Josue M. Polanco-Martinez [aut, cre] (<https://orcid.org/0000-0001-7164-0185>)

Maintainer Josue M. Polanco-Martinez <josue.m.polanco@gmail.com>

License GPL (>= 2)

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Contents

W2CWM2C-package *W2CWM2C: a graphical tool for wavelet (cross) correlation and wavelet multiple (cross) correlation analysis*

Description

The W2CWM2C package is a set of functions that improves the graphical presentations of the functions 'wave.correlation' and 'spin.correlation' (wavelet cross correlation) (*waveslim* package, Whitcher 2012) and the 'wave.multiple.correlation' and 'wave.multiple.cross.correlation' (*wavemulcor* package, Fernandez-Macho 2012b). The plot outputs (heatmaps) can be displayed in the screen or can be saved as PNG or JPG images or as PDF or EPS formats. The W2CWM2C package also helps to handle the (input data) multivariate time series easily as a list of N elements (times series) and provides a multivariate data set (dataexample) to exemplify its use. A description of the package was published by **Polanco-Martinez** and Fernandez-Macho (2014), <doi:10.1109/MCSE.2014.96>.

Details

Package:	W2CWM2C
Type:	Package
Version:	2.2
Date:	2021-01-07
License:	GPL (>= 2)
LazyLoad:	yes

The W2CWM2C package contains four functions: (1) `WC` that performs and plots the wavelet correlation for the bivariate case, (2) `WCC` that performs and plots the wavelet cross correlation for the bivariate case, (3) `WMC` that performs and plots the wavelet multiple correlation for the multivariate case, and 4) `WMCC` that performs and plots the wavelet multiple cross correlation for the multivariate case.

Note

Dependencies: *waveslim*, *wavemulcor* and *colorspace*.

Author(s)

Josue M. Polanco-Martinez (a.k.a. jomopo).
BC3 - Basque Centre for Climate Change, Bilbao, Spain.
Web1: https://scholar.google.es/citations?user=8djLIhcAAAAJ&hl=en.
Web2: https://www.researchgate.net/profile/Josue_Polanco-Martinez.
Email: josue.m.polanco@gmail.com

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Zeileis A, Hornik K, Murrell P (2009). Escaping RGBland: Selecting Colors for Statistical Graphics. *Computational Statistics & Data Analysis*, **53**, 3259–3270. doi: 10.1016/j.csda.2008.11.033.

dataexample *Stock market indexes (daily closing prices).*

Description

The data set *dataexample* contains seven European stock market indexes (daily closing prices): FTSE MIB30 (Italy), IBEX35 (Spain), DAX30 (Germany), CAC40 (France), AEX25 (Netherlands), ATX20 (Austria) and NBEL20 (Belgium) spanning from January 2, 2004 to June 29, 2012. In order to cope with the different official holidays, we have adjusted the raw indices data, carrying forward the closing price from the last working day before each of these holidays.

Usage

```
data(dataexample)
```

Format

A list containing 2216 elements and 7 variables

Source

https://finance.yahoo.com

WC *Wavelet correlation (bivariate case) pairwise comparisons.*

Description

The WC function (bivariate case) computes the wavelet correlation by means of the function *wave.correlation* of the *waveslim* package to several time series, makes a pairwise comparisons and plot the pairwise wavelet correlations in descending order as a single heatmap using the *colorspace* package. The input data are multivariate time series and WC function only tackle arrays with N x C (elements x columns, where the number of columns are between 2 and 7) dimensions.

Usage

```
WC(inputDATA, Wname, J, device="screen", filename,
   Hfig, WFig, Hpdf, Wpdf)
```

Arguments

inputDATA	An array of multivariate time series as a *ts* object (please, check the *ts* manual to get more information about the *ts* function in R).
Wname	The wavelet function or filter to use in the decomposition.
J	Specifies the depth of the decomposition.
device	The type of the output device (by default the option is "screen", and the other options are "jpg", "png", "eps" and "pdf").
filename	The output filename.
Hfig	The height of the 'jpg' or 'png' image.
WFig	The width of the 'jpg' or 'png' image.
Hpdf	The height of the 'eps' or 'pdf'.
Wpdf	The width of the 'eps' or 'pdf'.

Details

The WC function compute the wavelet correlation among time series and plots the results in a single heatmap plot (which can be displayed in the screen or can be saved as PNG, JPG, PDF or EPS) showing the WC values as a table (please, look at Figure 3 in **Polanco-Martinez** and Fernandez-Macho 2014). The WC code is based on the *wave.correlation* routine from Brandon Whitcher's *waveslim* R package Version: 1.7.1, which is based mainly on wavelet methodology developed by Whitcher, B., P. Guttorp and D.B. Percival (2000) and Gencay, Selcuk and Whitcher (2001).

Value

Output:

Output plot: *screen or 'filename + .png, .jpg, .eps or .pdf'*.

wavcor.modwtsDAT: matrix with as many rows as levels in the wavelet transform object. The first column provides the point estimate for the wavelet correlation followed by the lower and upper bounds from the confidence interval.

to3DpL: A matrix (the matrix table added in the WC plot) with a J (number of wavelet scales) X C (the number of pairwise comparisons) dimensions, which are in descending order taking into account the sum of the wavelet correlation coefficients for all (J) wavelet scales.

Note

Needs *waveslim* package to calculate *modwt*, *brick.wall* and the *wave.correlation* and also needs the *colorspace* package to plot the heatmaps.

Author(s)

Josue M. Polanco-Martinez (a.k.a. jomopo).
BC3 - Basque Centre for Climate Change, Bilbao, Spain.
Web1: https://scholar.google.es/citations?user=8djLIhcAAAAJ&hl=en.
Web2: https://www.researchgate.net/profile/Josue_Polanco-Martinez.
Email: josue.m.polanco@gmail.com.

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Examples

```
## Figure 3 (Polanco-Martinez and Fernandez-Macho 2014).

 library("colorspace")
 library("waveslim")
 library("W2CWM2C")
 data(dataexample)

 #:: Transforms to log returns using: ln(t + deltat) - ln(t).
 #:: The application in this example uses stock market
 #:: indexes (it is common to use log returns instead of
 #:: raw data). Other kinds of pre-processing data are possible.

 dataexample  <- dataexample[-1] # remove dates!
 dataexample  <- dataexample[,1:5]
 lrdatex      <- apply(log(dataexample), 2, diff)
 inputDATA    <- ts(lrdatex, start=1, frequency=1)

 #Input parameters
  Wname       <- "la8"
  J           <- 8
  compWC      <- WC(inputDATA, Wname, J, device="screen", NULL,
                    NULL, NULL, NULL, NULL)
```

WCC *Wavelet cross-correlation (bivariate case).*

Description

The WCC function (bivariate case) computes the wavelet cross correlation using the *spin.correlation* function of the *waveslim* package for two time series, and presents the result as a plot that reduce the number of plots of the classical function *spin.correlation*. The heatmap plot is built using the *colorspace* package and can be displayed in the screen or can be saved as PNG, JPG, PDF or EPS.

Usage

```
WCC(inputDATA, Wname, J, lmax, device="screen", filename,
    Hfig, WFig, Hpdf, Wpdf)
```

Arguments

inputDATA	A couple of time series as a *ts* object (please, check the *ts* manual to get more information about the *ts* function in R).
Wname	The wavelet function or filter to use in the decomposition.
J	Specifies the depth of the decomposition.
lmax	The maximum lag.
device	The type of the output device (by default the option is "screen", and the other options are "jpg", "png", "eps" and "pdf").
filename	The output filename.
Hfig	The height of the 'jpg' or 'png' image.
WFig	The width of the 'jpg' or 'png' image.
Hpdf	The height of the 'eps' or 'pdf'.
Wpdf	The width of the 'eps' or 'pdf'.

Details

The WCC function compute the wavelet cross-correlation between two time series and plot the results in a single heatmap plot (please, look at Figure 5 in **Polanco-Martinez** and Fernandez-Macho 2014). The *WCC* code is based on the *spin.correlation* routine from Brandon Whitcher's *waveslim* R package Version: 1.7.1, which is based mainly on wavelet methodology developed by Whitcher, B., P. Guttorp and D.B. Percival (2000) and Gencay, Selcuk and Whitcher (2001).

Value

Output:

Output plot: *screen or 'filename + .png, .jpg, .eps or .pdf'*.

returns.cross.cor: a matrix with the WCC values.

Note

Needs *waveslim* package to calculate *modwt*, *brick.wall* and *spin.correlation* and also needs the *colorspace* package to plot the heatmaps.

Author(s)

Josue M. Polanco-Martinez (a.k.a. jomopo).
BC3 - Basque Centre for Climate Change, Bilbao, Spain.
Web1: https://scholar.google.es/citations?user=8djLIhcAAAAJ&hl=en.
Web2: https://www.researchgate.net/profile/Josue_Polanco-Martinez.
Email: josue.m.polanco@gmail.com.

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Examples

```
## Figure 5 (Polanco-Martinez and Fernandez-Macho 2014)

 library("colorspace")
 library("waveslim")
 library("W2CWM2C")
 data(dataexample)

 #:: Transforms to log returns using: ln(t + deltat) - ln(t).
```

```
#:: The application in this example uses stock market
#:: indexes (it is common to use log returns instead of
#:: raw data). Other kinds of pre-processing data are possible.

dataexample  <- dataexample[-1] #remove the dates!
DAXCAC       <- dataexample[,c(3,4)]
lrdatex      <- apply(log(DAXCAC), 2, diff)
inputDATA    <- ts(lrdatex, start=1, frequency=1)

Wname     <- "la8"
J         <- 8
lmax      <- 30
compWCC   <- WCC(inputDATA, Wname, J, lmax, device="screen", NULL,
              NULL, NULL, NULL, NULL)
```

WMC *Wavelet multiple correlation (multivariate case).*

Description

The WMC function generates a plot to the wavelet routine for multiple correlation (*wave.multiple.correlation*) from the *wavemulcor* package (Fernandez-Macho 2012b). The WMC plot output can be displayed in the screen (by default) or can be saved as PNG, JPG, PDF or EPS. Furthermore, it also provides a way to handle multivariate time series easily as a list of N elements (time series).

Usage

```
WMC(inputDATA, Wname, J, device="screen", filename,
          Hfig, WFig, Hpdf, Wpdf)
```

Arguments

inputDATA	A couple of time series as a *ts* object (please, check the *ts* manual to get more information about the *ts* function in R).
Wname	The wavelet function or filter to use in the decomposition.
J	Specifies the depth of the decomposition.
device	The type of the output device (by default the option is "screen", and the other options are "jpg", "png", "eps" and "pdf").
filename	The output filename.
Hfig	The height of the 'jpg' or 'png' image.
WFig	The width of the 'jpg' or 'png' image.
Hpdf	The height of the 'eps' or 'pdf'.
Wpdf	The width of the 'eps' or 'pdf'.

Details

The WMC function helps to make and save easily the plot of the multiple correlation routine (*wave.multiple.correlation*) of the *wavemulcor* package (Fernandez-Macho 2012b). The WMC function also helps to manage easily multivariate time series to use the Wavelet multiple correlation routine.

Value

Output:

Output plot: *screen or 'filename + .png, .jpg, .eps or .pdf'*.

Output data: The same list of elements of the funtion *wave.multiple.correlation* of the *wavemulcor* package (Fernandez-Macho 2012b).

Note

Needs *wavemulcor* (to compute the *wave.multiple.correlation*) and *waveslim* packages (to compute the *modwt* and the *brick.wall*).

Author(s)

Josue M. Polanco-Martinez (a.k.a. jomopo)..
BC3 - Basque Centre for Climate Change, Bilbao, Spain.
Web1: https://scholar.google.es/citations?user=8djLIhcAAAAJ&hl=en.
Web2: https://www.researchgate.net/profile/Josue_Polanco-Martinez.
Email: josue.m.polanco@gmail.com.

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Examples

```
# This example is the wavelet multiple correlation (WMC) version of
# the Figure 7 in Polanco-Martinez and Fernandez-Macho (2014).

library("wavemulcor")
library("W2CWM2C")
```

```
data(dataexample)

#:: Transform to log returns using: ln(t + deltat) - ln(t).
#:: The application in this example uses stock market
#:: indexes (it is common to use log returns instead of
#:: raw data). Other kinds of pre-processing data are possible.

dataexample  <- dataexample[-1] #remove the dates!
dataexample  <- dataexample[,1:5]
lrdatex      <- apply(log(dataexample), 2, diff)
inputDATA    <- ts(lrdatex, start=1, frequency=1)

#Input parameters
 Wname       <- "la8"
 J           <- 8
 compWMC     <- WMC(inputDATA, Wname, J, device="screen", NULL,
                    NULL, NULL, NULL, NULL)
```

WMCC *Wavelet multiple cross-correlation (multivariate case).*

Description

The WMCC function (multivariate case) computes the wavelet multiple cross correlation by means of the function *wave.multiple.cross.correlation* from the *wavemulcor* package (Fernandez-Macho 2012b) and present the result as a novel plot that reduce the number of plots of the classical function *wave.multiple.cross.correlation*. The WMCC plot output can be displayed in the screen (by default) or can be saved as PNG, JPG, PDF or EPS. The WMCC function also provides a way to handle multivariate time series easily as a list of N elements (time series).

Usage

```
WMCC(inputDATA, Wname, J, lmax, device="screen", filename,
     Hfig, WFig, Hpdf, Wpdf)
```

Arguments

inputDATA	An array of multivariate time series as a *ts* object (please, check the *ts* manual to get more information about the *ts* function in R).
Wname	The wavelet function or filter to use in the decomposition.
J	Specifies the depth of the decomposition.
lmax	The maximum lag.
device	The type of the output device (by default the option is "screen", and the other options are "jpg", "png", "eps" and "pdf").
filename	The output filename.
Hfig	The height of the 'jpg' or 'png' image.

WFig	The width of the 'jpg' or 'png' image.
Hpdf	The height of the eps or pdf.
Wpdf	The width of the eps or pdf.

Details

The WMCC function compute the wavelet multiple cross correlation using the function *wave.multiple.cross.correlation* from the *wavemulcor* package (Fernandez-Macho 2012b), but the WMCC function incorporates some graphical improvements (please, look at Figure 7 in Polanco-Martinez and Fernandez-Macho 2014), such as the reduction of the number of plots to present the results of the function *wave.multiple.cross.correlation*.

Value

Output:
Output plot: *screen or 'filename + .png, .jpg, .eps or .pdf'*.

Output data: The same list of elements of the function *wave.multiple.cross.correlation* of the *wavemulcor* package (Fernandez-Macho 2012b).

Note

Needs *wavemulcor* (to compute the *wave.multiple.cross.correlation*) and *waveslim* packages (to compute the *modwt* and the *brick.wall*) and also needs the *colorspace* package to plot the heatmaps.

Author(s)

Josue M. Polanco-Martinez (a.k.a. jomopo).
BC3 - Basque Centre for Climate Change, Bilbao, Spain.
Web1: https://scholar.google.es/citations?user=8djLIhcAAAAJ&hl=en.
Web2: https://www.researchgate.net/profile/Josue_Polanco-Martinez.
Email: josue.m.polanco@gmail.com.

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MCSE.2014.96.

Examples

```
library("colorspace")
library("wavemulcor")
library("W2CWM2C")
data(dataexample)

#:: Figure 7 (Polanco-Martinez and Fernandez-Macho (2014).

#:: Transform log returns using: ln(t + deltat) - ln(t).
#:: The application in this example uses stock market
#:: indexes (it is common to use log returns instead of
#:: raw data). Other kinds of pre-processing data are possible.

dataexample  <- dataexample[-1] #remove the dates!
lrdatex      <- apply(log(dataexample), 2, diff)
inputDATA    <- ts(lrdatex, start=1, frequency=1)

Wname     <- "la8"
J         <- 8
lmax      <- 30
compWCC   <- WMCC(inputDATA, Wname, J, lmax, device="screen", NULL,
                  NULL, NULL, NULL, NULL)
```

Index