Package 'DFA'

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Type Package

Title Detrended Fluctuation Analysis

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Description Contains the Detrended Fluctuation Analysis (DFA), Detrended Cross-Correlation Analysis (DCCA), Detrended Cross-Correlation Coefficient (rhoDCCA), Delta Amplitude Detrended Cross-Correlation Coefficient (DeltarhoDCCA), log amplitude Detrended Fluctuation Analysis (DeltalogDFA), two DFA automatic methods for identification of crossover points and a Deltalog automatic method for identification of reference channels.

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Encoding UTF-8

LazyData true

Depends R (>= 2.10)

RoxygenNote 7.1.0

BugReports https://github.com/victormesquita40/DFA/issues

NeedsCompilation no

Repository CRAN

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R topics documented:

AUC *AUC*

Description

Applies the Area Under the Curve to time series.

Usage

```
AUC(x,data)
```

Arguments

x	x-axis time series (must be a vector)
data	A data.frame of time series

Details

Compute the Area Under the Curve to a data.frame.

Value

position	Position of the DFA curve with higher Area Under the Curve.
Area	Area Under the Curve by trapezoidal rule.

Note

All of time series contained in the data.frame must have the same sample size.

Author(s)

Victor Barreto Mesquita

References

https://www.khanacademy.org/math/ap-calculus-ab/ab-integration-new/ab-6-2/a/understanding-the-trapezoid-rule

https://en.wikipedia.org/wiki/Trapezoidal_rule

Examples

```
library(DFA)

eq = function(x){x^{2}}
eq2 = function(x){x^{2}-300}
eq3 = function(x){x^{2}+300}

x <- seq(1,100,1)
data <- data.frame(eq(1:100),eq2(1:100),eq3(1:100))

AUC(x,data)



# Example with polynomials with different slopes.
library(DFA)
curve = function(x){-x^{2}}
curve2 = function(x){-x^{2}+2*x - 400}
curve3 = function(x){-x^{2}-4*x-800}

x <- seq(1,80,1)
data <- data.frame(curve(1:80),curve2(1:80),curve3(1:80))

AUC(x,data)
```

`data1` *data1*

Description

A time series with one column.

Usage

```
data("data1")
```

Format

The format is: Time-Series [1:200] from 0 to 1: -0.089595464 0.017667207 -0.045008295 -0.115746279 -0.117493959 ...

Details

A single vector with one column:

Examples

```
library(DFA)
data("data1")
```

`data2` *data2*

Description

A time series with one column.

Usage

```
data("data2")
```

Format

The format is: Time-Series [1:200] from 0 to 1: 0.0293948 -0.0315427 -0.1081185 -0.2326447 -0.2165815 ...

Details

A single vector with one column:

Examples

```
library(DFA)
data("data2")
```

`data3` *data3*

Description

A time series with one column.

Usage

```
data("data3")
```

Format

The format is: Time-Series [1:200] from 0 to 1: -0.04827469 -0.02439724 -0.09959182 -0.16912343 -0.18852878 ...

Details

A single vector with one column:

Examples

```
library(DFA)
data("data3")
```

`data4` *data4*

Description

A time series with one column.

Usage

```
data("data4")
```

Format

The format is: Time-Series [1:200] from 0 to 1: -0.019939448 -0.097243289 -0.091787349 -0.044202712 0.037363582 ...

Details

A single vector with one column:

Examples

```
library(DFA)
data("data4")
```

`data5` *data5*

Description

A single vector DFA

Usage

```
data("data5")
```

Format

The format is: num [1:91] 5.31 7.18 11.39 16.16 21.5 ...

Examples

```
library(DFA)
data("data5")
```

`data6` *data6*

Description

A single vector DFA

Usage

```
data("data6")
```

Format

The format is: int [1:91] 4 5 7 9 11 13 16 20 23 28 ...

Examples

```
library(DFA)
data("data6")
```

`DCCA` *DCCA*

Description

Applies the Detrended Cross-Correlation Analysis (DCCA) to time series.

Usage

```
DCCA(file,file2,m=1)
```

Arguments

`file`	Univariate time series (must be a vector)
`file2`	Univariate time series (must be a vector)
`m`	An integer of the polynomial order for the detrending (by default m=1).

Details

The DCCA is computed in a geometric scale.

Value

box_size	Size of the windows computed in a geometric scale.
Log_n	decimal logarithmic of the box size.
DFA1	decimal logarithmic fluctuation function of the first time series.
DFA2	decimal logarithmic fluctuation function of the second time series.
DCCA	Detrended Cross-Correlation function.

Author(s)

Victor Barreto Mesquita

References

N. Xu, P. Shang, S. Kamae Modeling traffic flow correlation using DFA and DCCA Nonlinear Dynam., 61 (2010), pp. 207-216

B. Podobnik, D. Horvatic, A. Petersen, H.E. Stanley Cross-correlations between volume change and price change PNAS, 106 (52) (2009), pp. 22079-22084

R. Ursilean, A.-M. Lazar Detrended cross-correlation analysis of biometric signals used in a new authentication method Electr. Electron. Eng., 1 (2009), pp. 55-58

Examples

```
library(DFA)
data("data1")
data("data2")
file = data1
file2= data2

DCCA(file,file2,m=1)


# Example with different polynomial order.

library(DFA)
data("data3")
data("data4")
file = data3
file2= data4

DCCA(file,file2,m=2)
```

DeltaDFA *DeltaDFA*

Description

Applies the log-amplitude Detrended Fluctuation Analysis (DFA) to time series.

Usage

```
DeltaDFA(file,file2,m=1)
```

Arguments

file	Univariate time series (must be a vector)
file2	Univariate time series (must be a vector)
m	An integer of the polynomial order for the detrending (by default m=1).

Details

The DFA log-amplitude fluctuation is computed in a geometric scale.

Value

box_size	Size of the windows computed in a geometric scale.
Log_n	decimal logarithmic of the box size.
DeltaDFA	log-amplitude Fluctuation function.

Note

The time series file and file2 must have the same sample size.

Author(s)

Victor Barreto Mesquita

References

G. F. Zebende, F. M. Oliveira Filho, J. A. L. Cruz, Auto-correlationin the motor/imaginary human eeg signals: A vision about the fdfafluctuations, PloS one 12 (9) (2017).

F. Oliveira Filho, J. L. Cruz, G. Zebende, Analysis of the eeg bio-signalsduring the reading task by dfa method, Physica A: Statistical Mechanicsand its Applications 525 (2019) 664-671.

S. R. Hirekhan, R. R. Manthalkar, The detrended fluctuation and cross-correlation analysis of eeg signals, International Journal of IntelligentSystems Design and Computing 2 (2) (2018) .

Examples

```
library(DFA)
data("data1")
data("data2")
file = data1
file2= data2

DeltaDFA(file,file2,m=1)


# Example with different polynomial order.

library(DFA)
data("data3")
data("data4")
file = data3
file2= data4

DeltaDFA(file,file2,m=2)
```

Deltarho *Deltarho*

Description

Applies the Detrended Cross-Correlation Coefficient Difference (Deltarho) to time series.

Usage

```
Deltarho(file,file2,file3,file4,m=1)
```

Arguments

file	Univariate time series (must be a vector)
file2	Univariate time series (must be a vector)
file3	Univariate time series (must be a vector)
file4	Univariate time series (must be a vector)
m	An integer of the polynomial order for the detrending (by default m=1).

Details

The Deltarho is computed in a geometric scale.

Value

box_size	Size of the windows computed in a geometric scale.
Log_n	decimal logarithmic of the box size.
DFA1	decimal logarithmic fluctuation function of the first time series.
DFA2	decimal logarithmic fluctuation function of the second time series.
DFA3	decimal logarithmic fluctuation function of the third time series.
DFA4	decimal logarithmic fluctuation function of the fourth time series.
DCCA1	Detrended Cross-Correlation function between the first and the second time series.
DCCA2	Detrended Cross-Correlation function between the third and the fourth time series.
rhoDCCA1	Detrended Cross-Correlation Coefficient function between the first and the second time series.
rhoDCCA2	Detrended Cross-Correlation Coefficient function between the third and the fourth time series.

Note

The time series file,file2,file3 and file4 must have the same sample size.

Author(s)

Victor Barreto Mesquita

References

SILVA, Marcus Fernandes da et al. Quantifying cross-correlation between ibovespa and brazilian blue-chips: The dcca approach. Physica A: Statistical Mechanics and its Applications, v. 424,2015.

Examples

```
library(DFA)
data("data1")
data("data2")
data("data3")
data("data4")
file = data1
file2= data2
file3= data3
file4= data4

Deltarho(file,file2,file3,file4,m=1)


# Example with different polynomial order.
```

```
library(DFA)
file = rnorm(100)
file2= rnorm(100)
file3= rnorm(100)
file4= rnorm(100)

Deltarho(file,file2,file3,file4,m=4)
```

DFA *DFA*

Description

Applies the Detrended Fluctuation Analysis (DFA) to time series.

Usage

```
DFA(file,m=1)
```

Arguments

file	Univariate time series (must be a vector)
m	An integer of the polynomial order for the detrending (by default m=1).

Details

The DFA fluctuation is computed in a geometric scale.

Value

box_size	Size of the windows computed in a geometric scale.
Log_n	decimal logarithmic of the box size.
Log_Fn	decimal logarithmic of the Fluctuation function.

Author(s)

Victor Barreto Mesquita

References

C.-K. Peng, S.V. Buldyrev, S. Havlin, M. Simons, H.E. Stanley, A.L. Goldberger Phys. Rev. E, 49 (1994), p. 1685

H.E. Stanley, L.A.N. Amaral, A.L. Goldberger, S. Havlin, P.Ch. Ivanov, C.-K. Peng Physica A, 270 (1999), p. 309

P.C. Ivanov, A. Bunde, L.A.N. Amaral, S. Havlin, J. Fritsch-Yelle, R.M. Baevsky, H.E. Stanley, A.L. Goldberger Europhys. Lett., 48 (1999), p. 594

P. Talkner, R.O. Weber Phys. Rev. E, 62 (2000), p. 150

M. Ausloos, K. Ivanova Physica A, 286 (2000), p. 353

H.E. Hurst, R.P. Black, Y.M. Simaika Long-Term Storage, An Experimental Study, Constable, London (1965)

Examples

```
library(DFA)
data("data1")
file = data1
DFA(file,m=1)


# Example with different polynomial order.
library(DFA)
data("data2")
file = data2
DFA(file,m=3)
```

`euclidean` *euclidean*

Description

Applies the euclidean method for detection of crossover points to time series.

Usage

```
euclidean(x,y,npoint)
```

Arguments

`x`	x-axis time series (must be a vector).
`y`	y-axis time series (must be a vector).
`npoint`	Number of crossover points.

Value

position	Position of the crossover point.

Author(s)

Victor Barreto Mesquita

References

https://en.wikipedia.org/wiki/Distance_from_a_point_to_a_line

Examples

```
library(DFA)
data("data5")
data("data6")
x<-log10(data6)
y<-log10(data5)
npoint=2

euclidean(x,y,npoint)

#Example with different number of crossover
#points and other dataset.
library(DFA)
part1 <- seq(1,20)
part2 <- seq(20,1)
y = c(part1,part2)
x<-seq(1,40)
plot(x,y)
euclidean(x,y,npoint=1)
```

---

rhoDCCA *rhoDCCA*

Description

Applies the Detrended Cross-Correlation Coefficient (rhoDCCA) to time series.

Usage

```
rhoDCCA(file,file2,m=1)
```

Arguments

file	Univariate time series (must be a vector)
file2	Univariate time series (must be a vector)
m	An integer of the polynomial order for the detrending (by default m=1).

Details

The rhoDCCA is computed in a geometric scale.

Value

box_size	Size of the windows computed in a geometric scale.
Log_n	decimal logarithmic of the box size.
DFA1	decimal logarithmic fluctuation function of the first time series.
DFA2	decimal logarithmic fluctuation function of the second time series.
DCCA	Detrended Cross-Correlation function.
rhoDCCA	Detrended Cross-Correlation Coefficient function.

Note

The time series file and file2 must have the same sample size.

Author(s)

Victor Barreto Mesquita

References

Zebende G.F. DCCA cross-correlation coefficient: Quantifying level of cross-correlation Physica A, 390 (4) (2011), pp. 614-618

Vassoler R.T., Zebende G.F. DCCA cross-correlation coefficient apply in time series of air temperature and air relative humidity Physica A, 391 (7) (2012), pp. 2438-2443

Guedes E.F., Zebende G.F., da Cunha Lima I.C. Quantificacao dos Efeitos do Cambio na Producao da Industria de Transformacao Baiana: uma abordagem via coeficiente de correlacao cruzada rho dcca Conjuntura & Planejamento, 1 (192) (2017), pp. 75-89

Examples

```
library(DFA)
data("data1")
data("data2")
file = data1
file2= data2

rhoDCCA(file,file2,m=1)


# Example with different polynomial order.

library(DFA)
data("data3")
data("data4")
file = data3
```

```
file2= data4

rhoDCCA(file,file2,m=2)
```

---

secante *secante*

Description

Applies the secante method for detection of crossover points to time series.

Usage

```
secante(x,y,npoint)
```

Arguments

x	x-axis time series (must be a vector).
y	y-axis time series (must be a vector).
npoint	Number of crossover points.

Value

position	Position of the crossover point.

Author(s)

Victor Barreto Mesquita

Examples

```
library(DFA)
data("data5")
data("data6")
x<-log10(data6)
y<-log10(data5)
npoint=1

secante(x,y,npoint)

#Example with different number of crossover
#points and other dataset.
library(DFA)
part1 <- seq(1,20)
part2 <- seq(20,1)
y = c(part1,part2)
x<-seq(1,40)
```

```
plot(x,y)
secante(x,y,npoint=1)
```

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