Package ‘LPM’

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Description Apply Univariate Long Memory Models,
Multivariate Short Memory Models To Hydrological Dataset.

Imports stats, graphics, grDevices, fracdiff, MASS, QRM

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LPM-package *Linear Parametric Models Applied to Hydrological Series*

Description

Apply Univariate Long Memory Models, Multivariate Short Memory Models To Hydrological Dataset.

Details

See

ar.egls, lpm, mlpm rain.adapt

Author(s)

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References

Grimaldi S., Tallerini C., Serinaldi F. (2004) 'Modelli multivariati lineari per la generazione di serie di precipitazioni giornaliere' Giornata di Studio: Metodi Statistici e Matematici per l'Analisi Idrologiche Napoli 2004

Grimaldi S. , Serinaldi F. & Tallerini C. (2004) 'Multivariate linear parametric models applied to daily rainfall time series' Mediterranean Storms, 6rd EGU Plinius Conference held in Mediterranean Sea, Italy, October 2004

Lutkepohl, H. (1993) Introduction to Multiple Time Series Analysis 2nd edition, Springer-Verlag, Berlin.

Grimaldi, S., 'Linear parametric models applied on daily hydrological series', Journal of Hydrologic Engineering, Vol. 9, No 5 , September 2004.

Brockwell, P.J and Davis, R.A. (1990) Time Series: Theory and Methods 2nd edition, Springer, NY.

Hipel, K.W. and McLeod, A.I., (1994) Time Series Modelling of Water Resources and Enviromental Systems, Reading, UK.

Hosking, J.R.M. (1980) 'The Multivariate Portmanteau Statistic' Journal of the American Statistical Association, Vol.75, N.371, 502-608.

`ar.egls` *Subset Autoregressive Model*

Description

Estimate VAR(p) model fixing some parameter values to zero

Usage

```
ar.egls(x, R, order.max , na.action = na.fail, series = NULL, ...)
```

Arguments

`x`	Univariate or multivariate series with nil mean
`R`	Matrices of parameters selection
`order.max`	Model order
`na.action`	Function to be called to handle missing values
`series`	Names for the series. Defaults to 'deparse(substitute(x))'
`...`	See ar.ols

Details

R matrix is a list of p matrices, with p the autoregressive order. In R value '1' allows parameter estimation, '0' fix the parameter value to zero.

Value

See ar.ols

Note

Function is created modifing ar.ols by Adrian Trapletti and Brian Ripley

Author(s)

Corrado Tallerini

References

Grimaldi S. , Serinaldi F. & Tallerini C. (2004) 'Multivariate linear parametric models applied to daily rainfall time series' Mediterranean Storms, 6rd EGU Plinius Conference held in Mediterranean Sea, Italy, October 2004

Lutkepohl, H. (1993) Introduction to Multiple Time Series Analysis 2nd Edition ._ Springer Verlag, NY

Examples

```
## S1=matrix(0,3,3)
## S1[1,1]=1
## S1[1,2]=1
## S=list()
## S[[1]]=S1
## S[[2]]=S1
## ar.egls(series.rainfall[,1:3],S,order.max=2)
## --> Apply a Subset VAR(2) model restricted to 4 parameters (position (1,1)
## --> and (1,2) in both matrices) to first 3 series of series.rainfall
## --> dataset
```

Hourly.rainfall.series — *Hourly rainfall series*

Description

Hourly rainfall series recorded in BUrlington (US) during the period 2012-2015.

Usage

```
data(Hourly.rainfall.series)
```

Details

Dataset is available on The Iowa Environmental Mesonet (IEM) website

Source

https://mesonet.agron.iastate.edu/request/download.phtml?

Examples

```
data(Hourly.rainfall.series)
## maybe str(series.rainfall) ; plot(series.rainfall) ...
```

IDFcurve *Intensity duration frequency curve*

Description

Estimate IDF curve fitting a, m ,n parameters

Usage

```
IDFcurve(rain ,g, s, t, stvalue1=1, stvalue2=fre, fre, Tr=200, MP)
```

Arguments

`rain`	Univariate rainfall series non cumulative
`g`	Maximum bound for cumulative series. For daily series g = 7 is recommended, for hourly series g=24 is racommended
`s`	Threshold for defining "event". If "10", only h > = 10 mm values are considered
`t`	Time of concentration of Basin [h]
`stvalue1,stvalue2`	Starting values of estimation algorithm. Deault stvalue1=1, stvalue2=fre
`fre`	Series frequency [h]. For daily series fre=24, for hourly series fre=1
`Tr`	Return period in [y]. Default Tr=200
`MP`	logical: TRUE for 3 parameters formula i=a/(b+t)^m , FALSE for 2 parameters formula i=at^(n-1)

Details

Estimate parameters of Intensity Duration Frequency curves

Value

`par`	List of estimated parameters: a(tr), m, b, h(t), i(t), Offset of minimum squares optimizer
`Curve`	IDF curve Scattered point matrix

Note

a(tr) is defined by Gumbel distribution.

Author(s)

Corrado Tallerini

Examples

```
##    res = IDFcurve(Hourly.rainfall.series ,24, 15, 1, fre=1, Tr=200, MP=F)
## --> 2 parameters IDF curve estimation of a hourly rainfall series applying
## --> a Threshold "15 mm"  and Time of concentration t=1 h
##    res = IDFcurve(Hourly.rainfall.series ,24, 15, 1, fre=1, Tr=200, MP=T)
## --> 3 parameters IDF curve estimation of a hourly rainfall series applying
## --> a Threshold "15 mm"  and Time of concentration t=1 h
## --> It's obvious the best performance of the 3 parameters formula
```

---

lpm *Linear Parametric Model*

Description

Estimate ARMA and FARMA models, make simulations and ed eventually apply a corrective procedure to rainfall synthetic series. Besides you can remove seasonal components with STL modified method.

Usage

```
lpm(x, p, q, n, smean, svar, outer=0, prob = 0.95, fre = 365,
fractional = F, Plag = 20, lsign=0.05, n1 = 399, trasfo = F, des = T, rain = F, graph = F)
```

Arguments

x	Univariate series
p	AR order
q	MA order
n	Number of series to simulate
outer	Number of outer loops for STL modified method. Default outer = 0
smean, svar	Mean and Variance smoothing windows of STL modified method
prob	Parameter confidence interval. Default prob = 0.95
fre	Series frequency. Default fre = 365 (for daily series)
fractional	Logical variable: T to apply FARMA model. Default fractional = F
Plag	Maximum lag of ACF used in the Portmanteau test. Default Plag = 20
lsign	Portmanteau Test significance level. Default lsign = 0.05
n1	Number of parameters of infinite MA model . Default n1 = 399
trasfo	Logical variable: T for preventive logarithmical trasformation. Default trasfo = F
des	Logical variable: T to remove seasonal components. Default des = T
rain	Logical variable: T to apply the corrective procedure to daily rainfall simulated series. Default rain = F
graph	Logical variable: T to receive some graphics. Default graph = F

Details

Need integer periodical dataset. Function to complete modelling univariate series.

Value

`para`	List of estimated parameters
`res`	Residual series
`simdes`	List of simulated series without application of corrective procedure
`sim`	List of simulated series
`BIC`	Bayesian Information criterion index of estimated model

Note

Portmonteau test and BIC index are displaied during application. Portmonteau Test is positive if Q < chi square

Author(s)

Salvatore Grimaldi

References

Grimaldi, S., 'Linear parametric models applied on daily hydrological series', Journal of Hydrologic Engineering, Vol.9, No 5, September 2004.

Grimaldi S., F. Napolitano, L. Ubertini, 'A procedure to use linear parametric models for daily rainfall series simulation'

Brockwell, P.J and Davis, R.A. (1990) Time Series: Theory and Methods 2nd edition, Springer, NY.

Hipel, K.W. and McLeod, A.I., (1994) Time Series Modelling of Water Resources and Enviromental Systems, Reading, UK.

See Also

`rain.adapt`

Examples

```
##---  lpm(series.runoff,1,1,0,30,30,fractional=T,trasfo=T)
##--   Apply a FARMA(1,d,1) model to series.runoff after e preventive
##     logarithmical trasformation and deseasonalization with smoothing 30.
```

mlpm *Multivariate Linear Parametric Model*

Description

Multivariate modelling using VAR(p) and SVAR(p) different estimation methods, simulation, daily rainfall simulated series correction and deseasonalization are performed

Usage

```
mlpm(x, p, prob, nsim, smean, svar, fre = 365, outer = 0,plot = F,
rain = T, over = T, estimate = "ols", CCFlag = 20, Plag = 20, lsign = 0.05, des = T)
```

Arguments

`x`	Multivariate series
`p`	Model order
`prob`	Condifidence interval used to fix parameters in SVAR(p) model
`nsim`	Number of series to simulated
`smean , svar`	Mean and Variance smoothing windows of STL modified method
`fre`	Series frequency. Default fre = 365
`outer`	Outer loops of STL modified method. Default outer = 0
`plot`	Logical variable: T to receive some graphics. Default plot = F
`rain`	Logical variable: T to apply rain adaptor to simulated series. Default rain = F
`over`	Logical variable: T to use SVAR(p) model estimated with EGLS method. Need estimate = 'ols' Default over = T
`estimate`	Define VAR(p) estimation method. 'ols', 'burg', 'yw' (Yule-Walker). Default estimate = 'ols'
`CCFlag`	Lag of (Partial) Auto-CrossCorrelation function graphics . Default CCFlag = 20
`Plag`	Maximum lag of A-CCF used in the Portmanteau Test. Default Plag = 20
`lsign`	Portmanteau Test significance level. Default lsign = 0.05
`des`	Logical variable: T to remove seasonal components

Details

Need integer periodical datasets. Simulation use Lutkepohl algorithm with a residuals vectorial permutation to obtain innovations. Parameters selections of EGLS method is defined by t-ratio approach.

Value

`coeff`	List of estimated coefficients matrix
`coeffstd`	List of estimated standard deviations coefficients matrix. Only for OLS and EGLS method
`struct`	List of 'structure' of SVAR(p) model (1 define position of estimated parameter). Only for EGLS method
`res`	Residual series
`fit`	Output List of ar function
`aic`	Akaike Information Criterion index
`Q`	Portmonteau statistic
`sim`	List of simulated series

Note

Portmonteau test, AIC e SBC index are displaied during application. Portmonteau test is positive if Q < chi square.

Author(s)

Corrado Tallerini

References

Grimaldi S., Tallerini C., Serinaldi F. (2004) 'Modelli multivariati lineari per la generazione di serie di precipitazioni giornaliere' Giornata di Studio: Metodi Statistici e Matematici per l'Analisi Idrologiche Napoli 2004

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Hosking, J.R.M. (1980) 'The Multivariate Portmanteau Statistic' Journal of the American Statistical Association, Vol.75, N.371, 502-608.

See Also

`lpm`, `ar.egls`, `rain.adapt`

Examples

```
##-- Mrain=mlpm(series.rainfall,3,0.95,0,120,120)
##-- Apply a SVAR(3) model with selection probability 95 % to series.rainfall
##-- after preventive deseasonalization with smoothing 120.
```

---

rain.adapt *Rainfall Adaptor*

Description

Apply a corrective procedure to daily rainfall series to enforce actual caracteristics.

Usage

```
rain.adapt(x, a, ser)
```

Arguments

x	Observed series
a	Univariate series to modify (simulated series)
ser	Series identification number

Details

The no-rain frequency consequentally the total rainfall depth of the observed series are enforced on the synthetic series

Value

Corrected series

Author(s)

Salvatore Grimaldi

References

Grimaldi S., F. Napolitano, L. Ubertini, 'A procedure to use linear parametric models for daily rainfall series simulation'

Examples

```
##   rain=lpm(series.rainfall[,1],1,1,1,120,120)
##   rain.adapt(series.rainfall[,1],rain$sim[[1]],1)
##-- ==>  Apply rain adaptor to a simulated series with a ARMA(1,1) model
```

series.rainfall *Daily Rainfall Series*

Description

Group of 5 daily rainfall series recorded in Tuscany region of Italy during the period 1958-1979.

Usage

```
data(series.rainfall)
```

Details

Dataset is created removing lacking years and replacing lacking days with the mean of previous and successive value. Beside 29 february day values are removed to obtain integer periodical dataset.

Source

Rudari, R. 'Predicibilita' del clima europeo ed influenze delle forzanti a scala sinottica su eventi regionali di precipitazione intensa', PDh Thesis 2001

Examples

```
data(series.rainfall)
## maybe str(series.rainfall) ; plot(series.rainfall) ...
```

series.runoff *Daily Runoff Series*

Description

Daily runoff series of Tiber river observed to Ripetta station during the period 1930-1983

Usage

```
data(series.runoff)
```

Details

29 february day values are removed to obtain integer periodical dataset

Source

Available on the web site www.gndci.cnr.it. "Gruppo nazionale per la difesa delle catastrofi idrogeologiche"

Examples

```
data(series.runoff)
## maybe str(series.runoff) ; plot(series.runoff) ...
```

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