Package 'SPIGA'

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Type Package

Title Compute SPI Index using the Methods Genetic Algorithm and Maximum Likelihood

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NeedsCompilation no

Description Calculate the Standardized Precipitation Index (SPI) for monitoring drought, using Artificial Intelligence techniques (SPIGA) and traditional numerical technique Maximum Likelihood (SPIML). For more information see: http://drought.unl.edu/monitoringtools/downloadablespiprogram.aspx.

Depends GA

License GPL-2

LazyData TRUE

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R topics documented:

Drought Index *Calculation of Standardized Precipitation Index, using the Genetic Algorithm Method (SPIGA) and Maximum Likelihood (SPIML)*

Description

Calculate the standardized precipitation index (SPI) for monitoring drought using the technique of Genetic Algorithm (SPIGA) and Maximum Likelihood (SPIML) of a series of monthly rainfall for different time scales.

Usage

```
SPIGA(Pmon, scale = 3, population = 500, maxIter = 50, plotGA = FALSE, plotCDF = FALSE)

SPIML(Pmon, scale =3)
```

Arguments

Pmon	monthly precipitation series ordered according to time. It is a data frame with columns: year, month, station 1, station 2, etc.
scale	an integer value representing the time scale of analysis. The most common are 1, 3, 6, 9, 12, 48, etc.
population	an integer value that sets the number of population for the use of the technique of Genetic Algorithm.
maxIter	an integer value that sets the maximum number of iterations also called cycles within the concept of Genetic Algorithm.
plotGA	optional, value Boolean default false. Shows the performance versus the number of cycles in the Genetic Algorithm.
plotCDF	optional, value Boolean default false. Shows the cumulative distribution function of each station. The graphics are monthly.

Details

The SPIGA and SPIML, are functions to calculate the SPI using Artificial Intelligence techniques - Genetic Algorithms (GA) and numerical method - Maximum Likelihood (ML) and both provide quantitative results for monitoring DROUGHT. The GA optimize the parameters alpha and beta of the probability function Gamma given by McKee.

The population parameter must be an integer and balanced value, large values can generate higher time run, ie, high computational effort and small values can influence the accuracy of the results. By plotGA option and its corresponding graph, you can see the number of cycles to obtain a proper balance of the accuracy of the results and the computational effort.

Input data: similar to Pm_Pisco.

Year	Mon	st_1	st_2	st_3	st_4
1981	1	120.25	125.25	90.55	150.25

1981	2	145.25	140.25	120.70	145.50
1981	3	120.80	150.28	90.50	130.40
1981	4	90.25	80.25	70.52	120.40
1981	5	50.25	58.25	60.50	80.50
1981	6	40.25	38.45	80.25	50.40
1981	7	20.25	30.69	50.40	40.40
1981	8	1.25	8.85	10.40	25.80
1981	9	25.25	14.25	5.80	20.80
1981	10	13.25	10.23	10.50	30.45
1981	11	50.25	40.25	30.50	80.50
1981	12	80.25	90.52	80.70	90.40
1982	1	145.80	110.25	105.40	120.25
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.

Value

Functions SPIGA and SPIML return values saved in .txt formats (Tabular) and .pdf (graphics). They are located in the working folder of R [getwd()].

Note

Dependencies: the SPIGA function, depend on the library GA.

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References

McKee, Thomas B. and Doesken, Nolan J. and Kleist, John. 1993. The relationship of Drought Frequency and Duration to Time Scales. *Eighth Conference on Applied Climatology*

A. Belauneh and J. Adamowski. Standard Precipitation Index Drought Forecasting Using Neural Networks, Wavelet Neural Networks, and Support Vector Regression. *Applied Computational Intelligence and Soft Computing*, http://dx.doi.org/10.1155/2012/794061

See Also

SPIFromParameters to calculate the standardized precipitation index, from alpha and beta parameter of the Gamma function.

Examples

```
#### Load data
data(Pm_Pisco)
Pmon<-Pm_Pisco      # dataframe Precipitation
```

```
summary(Pm_Pisco)   # view summary
Pmon<-Pm_Pisco[,]

#### Computing SPI with Genetic Algorithms
pob     <-50        # Define population number
iMax    <-10        # Define Max iteration

# Total stations calculation. It may take some time.
#SPIGA(Pmon, scale=3, population=pob, maxIter = iMax, plotGA=TRUE, plotCDF=TRUE)

# station 1 computing
Pmon1<-data.frame(Pmon[,1:2], Pmon$Pm_St1)
SPIGA(Pmon1, scale=3, population=pob, maxIter = iMax)

# station 2 computing
Pmon2<-data.frame(Pmon[,1:2], Pmon$Pm_St2)
SPIGA(Pmon2, scale=3, population=pob, maxIter = iMax)

#### Computing SPI with Maximun Likelihood
SPIML(Pmon, scale=3)
```

`Drought Index from Parameters`

Calculation of standardized precipitation index from alpha and beta parameter of the Gamma function.

Description

calculate the standardized precipitation index, from alpha and beta parameter of the Gamma function.

Usage

```
SPIFromParameters(Pmon, scale =3, Param_Alpha, Param_Beta)
```

Arguments

`Pmon`	monthly precipitation series ordered according to time. It is a data frame with columns: year, month, station 1, station 2, etc.
`scale`	an integer value representing the time scale of analysis. The most common are 1, 3, 6, 9, 12, 48, etc.
`Param_Alpha`	data frame monthly data values corresponding to the alpha parameter to the function Gamma.
`Param_Beta`	data frame monthly data values corresponding to the alpha parameter to the function Gamma.

Details

Analysis stations are in the columns of dataframe. the apha and beta parameters, are monthly and are in the rows of dataframe.

Input data: similar to `Pm_Pisco`.

Mon	st_1	st_1	st_2	st_3
Jan	9.584860915	9.227918987	10.35269003	8.433823824
Feb	13.76378505	15.02620223	12.1021093	10.85133914
Mar	26.09112343	17.41749632	21.10924889	23.53649421
Apr	17.34996675	17.4451073	13.00894394	16.66595319
May	9.943259493	9.46815537	9.164645239	9.455850664
Jun	5.103175852	5.041710686	4.080851346	5.790986084
Jul	2.85804336	3.042484994	2.797962575	2.645188236
Aug	3.033862506	3.183267843	3.435303986	2.631287947
Sep	3.815308513	2.627317533	3.550365645	3.66482456
Oct	7.430925356	3.956716609	7.023105167	7.540706878
Nov	6.303310502	5.339943557	6.358902249	5.556660824
Dec	5.84110559	5.899534971	6.581657735	4.889599504

Value

return values of standardized precipitation index in .txt formats.

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References

McKee, Thomas B. and Doesken, Nolan J. and Kleist, John. 1993. The relationship of Drought Frecuency and Duration to Time Scales. *Eighth Conference on Applied Climatology*

A. Belauneh and J. Adamowski. Standard Precipitation Index Drought Forecasting Using Neural Networks, Wavelet Neural Networks, and Support Vector Regression. *Applied Computational Intelligence and Soft Computing*, http://dx.doi.org/10.1155/2012/794061

Examples

```
#### Load data
data(Pm_Pisco)
data(alphaGA_SPI3)
data(betaGA_SPI3)

#### Computing SPI with Genetic Algorithms
Pmon<-Pm_Pisco
Param_Alpha <- alphaGA_SPI3
Param_Beta <- betaGA_SPI3
```

```
SPIFromParameters(Pmon, scale =3, Param_Alpha, Param_Beta)
```

`Generic methods for spei objects`
Generic methods for `SPIGA` *objects.*

Description

Generic methods for extracting information and plotting `SPIGA` objects.

Usage

```
calcSPI(Pt,alpha, beta,m, nd)
```

Arguments

`Pt`	monthly precipitation series.
`alpha`	parameter to Gamma function.
`beta`	parameter to Gamma function.
`m`	Number of zeros in the column.
`nd`	Number total data.

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References

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`SPIDataset` *The data set for illustratrating the functions of the SPIGA package*

Description

The set used, data are monthly rainfall (1981-2015) and the dimensionless parameters to calculate the SPI drought.

Usage

```
data(Pm_Pisco)
data(alphaGA_SPI3)
data(betaGA_SPI3)
```

Format

`Pm_Pisco` dataframe with:

YEAR monthly precipitation totals, in mm.

MONTH monthly precipitation totals, in mm.

P1 monthly precipitation totals st-1, in mm.

P2 monthly precipitation totals st-2, in mm.

... monthly precipitation totals st-n, in mm.

`alphaGA_SPI3` dataset: monthly alpha parameter.

mon month analysis

st-1 monthly alpha parameter station 1

st-2 monthly alpha parameter station 2

st-n monthly alpha parameter station n

`betaGA_SPI3` dataset: monthly beta parameter.

mon month analysis

st-1 monthly beta parameter station 1

st-2 monthly beta parameter station 2

st-n monthly beta parameter station n

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Source

The `Pm_Pisco` data were obtained from the Peruvian Interpolation data of the SENAMHI's Climatological and Hidrological Observations, SENAMHI-PERU. http://peruclima.pe/.

References

McKee, Thomas B. and Doesken, Nolan J. and Kleist, John. 1993. The relationship of Drought Frequency and Duration to Time Scales. *Eighth Conference on Applied Climatology*

A. Belauneh and J. Adamowski. Standard Precipitation Index Drought Forecasting Using Neural Networks, Wavelet Neural Networks, and Support Vector Regression. *Applied Computational Intelligence and Soft Computing*, http://dx.doi.org/10.1155/2012/794061

Examples

```
data(Pm_Pisco)
names(Pm_Pisco)
summary(Pm_Pisco)

data(alphaGA_SPI3)
names(alphaGA_SPI3)
summary(alphaGA_SPI3)

data(betaGA_SPI3)
names(betaGA_SPI3)
summary(betaGA_SPI3)
```

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