Package 'STI'

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Type Package

Title Calculation of the Standardized Temperature Index

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Description A set of functions for computing the Standardized Temperature Index (STI).

License GPL-3

Imports fitdistrplus, zoo

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STI-package   *Compute the Standardized Temperature Index*

Description

A set of functions for computing the standardized temperature index (STI).

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Details

STI is an index representing the probability of occurrence of a temperature value when compared with temperature values on a longer period. Positive and negative STI values indicate temperatures above and below the median temperature of the long-term time period respectively. It can be used to identify anomalously hot and cold periods.

STI values are classified into "events" according to the following rules:

```
"Extremely hot"     when STI >=  2.00
"Very hot"           ''  STI >=  1.50 and <  2.00
"Moderately hot"     ''  STI >=  1.00 and <  1.50
"Near normal"        ''  STI <   1.00 and > -1.00
"Moderately cold"    ''  STI <= -1.00 and > -1.50
"Very cold"          ''  STI <= -1.50 and > -2.00
"Extremely cold"     ''  STI <= -2.00
```

Categories are relative to the temperatures at a particular location, but the standardization of the index allows for comparison across space and time at any geographic coordinate on the globe.

The STI is closely related in its principe to the Standardized Precipitation Index (SPI) as described originally in McKee and al. (1993): http://ccc.atmos.colostate.edu/relationshipofdroughtfrequency.pdf

[sti](sti) is the main function of the package and computes the index on a time ordered series of temperature values. It returns a time ordered series of STI values taking into consideration a specified time scale on which the calculation is performed. Please, see the [sti](sti) help page for more details.

The package includes also a function stiEvents computing the number of events occuring in a time series of STI values. See stiEvents help page for more details.

Version history:

0.1. First release.

Author(s)

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engelberg	*Monthly temperature and precipitation values at Engelberg station, Switzerland*

Description

A dataset containing monthly homogenized temperature and precipitation values recorded at the Engelberg meteorological station in Switzerland (Altitude: 1036 m; Coordinates: 46.8175N / 8.4017E).

Reference date of homogenization: Temperature: 01.12.2009; Precipitation: 01.12.2007

The variables are as follows:

- Year. Year of the record (1864–2015)
- Month. Month of the record (1–12)
- Temperature. Temperature in degrees C
- Precipitation. Precipitation in mm

Usage

```
data(engelberg)
```

Format

A data frame with 1819 rows and 4 variables.

Source

Federal Office of Meteorology and Climatology MeteoSwiss

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sti	*Compute standardized temperature indices*

Description

`sti` returns a time series of standardized temperature indices (STI).

Usage

```
sti(values, scale)
```

Arguments

`values`	a time ordered vector of temperature values.
`scale`	an integer representing the time scale at which the STI will be computed.

Details

The `sti` function allows computing the STI.

In essence, the function standardizes a variable following a normal distribution function (which is assumed to be the case for temperature values given as input to the function). It is designed to be used with monthly values.

STI values can be computed on different time scales given in number of months to the function. Typical values are 1, 3, 6, 12, 24 or 48 for monthly, seasonal, annual or interannual calculation.

In practice, computation of the STI is made first by averaging temperature values over the time scale specified for each month of the time series. For example, on a time series of 1,200 consecutive monthly temperature values over a century:

- if time scale equals 1, the time series will stay unchanged (each month is averaged by itself);

- if time scale equals 3, the averaged values of the two first months will be NA as it is not possible to calculate an average on three values for them. Then for each successive month it will be the average of the month and the two previous months. Averaged value for month 3 will thus be the average of months 1, 2 and 3, etc. until month 1,200 that will be the average of months 1,198, 1,199 and 1,200;
- ... the same principle applies for any time scale, as for example with a time scale equals 12, the average of the eleven first months will be NA and then calculated with values of the month and the eleven previous months.

Once average values are calculated, the function extracts the values for the twelve months of the year and fits normal probability density functions (PDFs) to the frequency distribution of the averaged values. The mu and sigma parameters of the normal probability density functions are thus estimated for each month of the year using the maximum-likelihood estimation (MLE) method.

The PDFs are then standardized with mean equals zero and standard deviation equals one. Twelve standardized PDFs are thus obtained to determine the probability of occurrence of a temperature value for a given month.

A STI value is actually the initial temperature value transformed into a standard deviation from the median of the standardized normal distribution of the temperature values of the same month in the time series.

The cumulative probabilities for the various STI values and interpretation can be summed as follow:

```
        Cumulative                                     Probability
 STI    Probability  Interpretation   Class            of occurrence
----------------------------------------------------------------------
+2.0    0.9772       Extremely hot    STI >= +2.0      0.023
+1.5    0.9332       Very hot         +1.5 >= STI < +2.0   0.044
+1.0    0.8413       Moderately hot   +1.0 >= STI < +1.5   0.092
 0.0    0.5000       Near normal      -1.0 >  STI < +1.0   0.682
-1.0    0.1587       Moderately cold  -1.0 <= STI > -1.5   0.092
-1.5    0.0668       Very cold        -1.5 <= STI > -2.0   0.044
-2.0    0.0228       Extremely cold   -2.0 <= STI          0.023
----------------------------------------------------------------------
```

Input data: The STI is designed to be used with monthly values.

There is currently no fine tuned control on the input data. Please make sure your input data is a valid vector of integer or float time ordered temperature values not containing NAs. If NAs occur in your data, all months used for the computation of the averaged values will not be taken into account for fitting the PDFs.

Time scale: Typical values are 1, 3, 6, 12, 24 and 48.

There is currently no fine tuned control on the parameter. Please make sure the scale parameter is an integer between 1 and a resonable number for interannual computation of the index, typically 24 or 48.

Fitting method: Parameter fitting is based on the maximum-likelihood estimation method.

Value

Function `sti` returns a time ordered series of STI values.

Note

Dependencies: the sti function depends on the libraries fitdistrplus and zoo.

Author(s)

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Examples

```
data(engelberg)

sti(engelberg$Temperature, 12)
```

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stiEvents   *Compute events from STI values*

Description

stiEvents returns a vector containing events occurence computed from the given STI values.

Usage

```
stiEvents(values)
```

Arguments

values   a time ordered series of STI values.

Details

The stiEvents function allows computing events from a time ordered series of STI values. Events are defined as:

```
"Extremely hot"    when STI >=  2.00
"Very hot"          ''  STI >=  1.50 and <  2.00
"Moderately hot"    ''  STI >=  1.00 and <  1.50
"Near normal"       ''  STI <   1.00 and > -1.00
"Moderately cold"   ''  STI <= -1.00 and > -1.50
"Very cold"         ''  STI <= -1.50 and > -2.00
"Extremely cold"    ''  STI <= -2.00
```

Value

stiEvents returns a vector of events occurence from "Extremely hot" to "Extremely cold".

Author(s)

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Examples

```
data(engelberg)

stiEvents(sti(engelberg$Temperature, 12))
```

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