Package 'IETD'

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Type Package

Title Inter-Event Time Definition

Version 1.0.0

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Description Computes characteristics of independent rainfall events (duration, total rainfall depth, and intensity)
extracted from a sub-daily rainfall time series based on the interevent time definition (IETD) method. To have a
reference value of IETD, it also analyzes/computes IETD values through three methods: autocorrelation analysis, the
average annual number of events analysis, and coefficient of variation analysis. Ideal for analyzing the sensitivity
of IETD to characteristics of independent rainfall events.
Adams B, Papa F (2000) <ISBN: 978-0-471-33217-6>.
Joo J et al. (2014) <doi:10.3390/w6010045>.
Restrepo-Posada P, Eagleson P (1982) <doi:10.1016/0022-1694(82)90136-6>.

License GPL-3

Encoding UTF-8

LazyData true

Imports Rdpack,foreach,parallel,doParallel,ggplot2,dplyr,lubridate,stats

RdMacros Rdpack

Depends R (>= 2.10)

RoxygenNote 7.0.2

Suggests testthat

NeedsCompilation no

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Contents

AAEA   *Average annual number of events analysis*

Description

This function provides the required figure to define the inter-event time definition (IETD) based on the average annual number of events analysis.

Usage

```
AAEA(Time_series,MaxIETD,xlabel,ylabel)
```

Arguments

Time_series	A dataframe. The first column contains the time and day of a rainfall pulse and the second one the depth of rainfall in each time step. The date must be as POSIXct class.
MaxIETD	The maximum value of IETD to be analyzed (in hours). Default value 24.
xlabel	Label of the x-axis.
ylabel	Label of the y-axis.

Details

This analysis is based on the computation of the average annual number of events (AAE) for several IETD values, the appropriate value of IETD is determined as the point where increasing IETD does not change AAE significantly (Joo et al. 2014; Adams and Papa 2000). The analyst, thus, uses the plot of IETD vs AAE to define that value.

Value

A list with the figure of IETD (in hours) vs AAE and a dataframe with its values.

Note

To review the concept of IETD, go to the details of drawre function.

Author(s)

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References

Adams BJ, Papa F (2000). *Urban Storm water Management Planning with Analytical Probabilistic Models*. John Wiley and Sons, New York, NY. ISBN 0-471-35641-7.

Joo J, Lee J, Kim JH, Jun H, Jo D (2014). "Inter-event time definition setting procedure for urban drainage systems." *Water (Switzerland)*. ISSN 20734441, doi: 10.3390/w6010045.

Examples

```
AAEA(Time_series=hourly_time_series)
```

AutoA   *Autocorrelation analysis*

Description

This function provides the required figure (an autocorrelogram) to define the inter-event time definition (IETD) based on the autocorrelation analysis.

Usage

```
AutoA(Time_series,MaxLag,CL,xlabel,ylabel)
```

Arguments

Time_series	A dataframe. The first column contains the time and day of a rainfall pulse and the second one the depth of rainfall in each time step. The date must be as POSIXct class.
MaxLag	The maximum lag time to be analyzed (in hours). Default value 24.
CL	The confidence level of the autocorrelation function (ACF)(in percentage). Default value 95%.
xlabel	Label of the x-axis of the autocorrelogram.
ylabel	Label of the y-axis of the autocorrelogram.

Details

IETD is here defined as the lag time where the autocorrelation coefficient of rain pulses, i.e., the autocorrelation function(ACF), converges to zero (Joo et al. 2014; Adams and Papa 2000). The analyst uses an autocorrelogram to define that value within a specific level of tolerance. This function is based on the function acf of the stats package.

Value

A list with a figure of lag time (in hours) vs ACF, i.e., an autocorrelogram, and a dataframe with its values.

Note

To review the concept of IETD, go to the details of drawre function.

Author(s)

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References

Adams BJ, Papa F (2000). *Urban Storm water Management Planning with Analytical Probabilistic Models*. John Wiley and Sons, New York, NY. ISBN 0-471-35641-7.

Joo J, Lee J, Kim JH, Jun H, Jo D (2014). "Inter-event time definition setting procedure for urban drainage systems." *Water (Switzerland)*. ISSN 20734441, doi: 10.3390/w6010045.

Examples

```
AutoA(Time_series=hourly_time_series)
```

CVA   *Coefficient of variation analysis*

Description

This function computes the inter-event time definition (IETD) based on the coefficient of variation analysis.

Usage

```
CVA(Time_series,MaxIETD,xlabel,ylabel)
```

Arguments

Time_series	A dataframe. The first column contains the time and day of a rainfall pulse and the second one the depth of rainfall in each time step. The date must be as POSIXct class.
MaxIETD	The maximum value of IETD to be analyzed (in hours). Default value 24.
xlabel	Label of the x-axis of the figure IETD vs CV.
ylabel	Label of the y-axis of the figure IETD vs CV.

Details

This method assumes that inter-event times (b) are represented well by a exponential distribution. Since by definition b>= IETD, IETD is computed as the value whose resulting coefficient of variation (CV) of b equal to unity (Restrepo-Posada and Eagleson 1982; Adams and Papa 2000). This analysis is done by testing several values of IETD and analyzing the resulting CV. The computed IETD is obtained via interpolation from the figure of IETD vs CV.

Value

A list with a figure of IETD vs CV, a dataframe with the values of that figure, and the computed value of IETD.

Note

To review the concepts of b and IETD, go to the details of drawre function.

Author(s)

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References

Adams BJ, Papa F (2000). *Urban Storm water Management Planning with Analytical Probabilistic Models*. John Wiley and Sons, New York, NY. ISBN 0-471-35641-7.

Restrepo-Posada PJ, Eagleson PS (1982). "Identification of independent rainstorms." *Journal of Hydrology*. ISSN 00221694, doi: 10.1016/00221694(82)901366.

Examples

```
CVA (Time_series=hourly_time_series)
```

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drawre   *Extraction of independent rainfall events from a sub-daily time series*

Description

This function draws rainfall events from a sub-daily rainfall time series based on the inter-event time definition (IETD) method and computes the event characteristics such as duration, total rainfall depth, and intensity. The function allows slight rainfall events to be characterized, which are, in turn, not considered in the extraction of rainfall events.

Usage

```
drawre(Time_series,IETD,Thres)
```

Arguments

`Time_series`	A dataframe. The first column contains the time and day of a rainfall pulse and the second one the depth of rainfall in each time step. The date must be as POSIXct class.
`IETD`	The minimum rainless period or dry period (hours) to be considered between two independent rainfall events.
`Thres`	A rainfall depth threshold to define slight rainfall events (default value 0.5).

Details

IETD is defined as the minimum dry or rainless period between two independent events. This time interval is applied to a continuous time series: if two groups of consecutive pulses of rainfall are separated by a rainless period longer than or equal to IETD, they are considered as two independent rainfall events; otherwise, these two groups are categorized as belonging to the same event (Restrepo-Posada and Eagleson 1982; Adams and Papa 2000). A rainless period between two independent events is known as inter-event time (b) and by definition b>= IETD. A rainfall event whose rainfall pulses are lower than the threshold Thres is characterized as a slight rainfall event.

Value

A list with a dataframe, named Rainfall_Characteristics, and a sublist, named Rainfall_Events, is provided. Rainfall_Characteristics contains the main information of each extracted rainfall event such as event number, the beginning and end of the event, duration (in hours), total rainfall depth, and average intensity (total rainfall depth/duration). Rainfall_Events contains several dataframes with the values of rainfall pulses of each extracted rainfall event. The first dataframe in Rainfall_Events corresponds to the first event in Rainfall_Characteristics, the second dataframe in Rainfall_Events corresponds to the second event in Rainfall_Characteristics, and so on.

Note

This function does not accept missing values in the sub-daily rainfall time series.

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References

Adams BJ, Papa F (2000). *Urban Storm water Management Planning with Analytical Probabilistic Models*. John Wiley and Sons, New York, NY. ISBN 0-471-35641-7.

Restrepo-Posada PJ, Eagleson PS (1982). "Identification of independent rainstorms." *Journal of Hydrology*. ISSN 00221694, doi: 10.1016/00221694(82)901366.

Examples

```
drawre(Time_series=hourly_time_series,IETD=5,Thres=0.5)
```

```
five_minute_time_series
```
                                5-min rainfall time series

Description

An artificial 5-min rainfall dataset to test the functions of the package.

Usage

```
five_minute_time_series
```

Format

A data frame with columns:

Date The time and day of the rainfall pulse

Rainfall.depth The depth of rainfall in each time step

Source

Artificial data, it does not come from any source.

Examples

```
## Not run:
 five_minute_time_series

## End(Not run)
```

```
hourly_time_series
```
                        Hourly rainfall time series

Description

An artificial hourly rainfall dataset to test the functions of the package.

Usage

```
hourly_time_series
```

Format

A data frame with columns:

Date The time and day of the rainfall pulse

Rainfall.depth The depth of rainfall in each time step

Source

Artificial data, it does not come from any source.

Examples

```
## Not run:
 hourly_time_series

## End(Not run)
```

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