Package ‘lfstat’

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Author Daniel Koffler and Gregor Laaha
Maintainer Gregor Laaha <gregor.laaha@boku.ac.at>
Description The "Manual on Low-flow Estimation and Prediction", published by the World Meteorological Organisation (WMO), gives a comprehensive summary on how to analyse stream flow data focusing on low-flows. This package provides functions to compute the described statistics and produce plots similar to the ones in the manual.
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lfstat-package

Calculates Low Flow Statistics for daily stream flow data

Description

The "Manual on Low-flow Estimation and Prediction", published by the World Meteorological Organisation (WMO), gives an idea how to analyse stream flow data focusing on low-flow issues. This package gives functions to compute the described statistics and produce plots similar to the one in the manual.

Details

### Create lfobj (Low-Flow-Objects)

The package calculates indices and makes graphics for low flow analysis. It brings its own class "lfobj", a special data.frame format with columns "day", "month", "year", "flow", "hyear" and possibly "baseflow".

"day", "month" and "year" refer to the date, "flow" is the measured runoff (unit-independent), "baseflow" the calculated baseflow.

"hyear" refers to the hydrological year. When creating the "lfobj" you define the month where the stations hydrological year starts. If annual indices are calculated or single years are plotted, the "hyear" is taken.

Basically there are two options to create an lfobj:

If you have special data format, e.g. GRDC, you can use the function `readlfdata`, see '?readlfdata' to see which formats are currently supported. Otherwise you can use `createlfobj`. You can apply it for new data in one of two ways: 1) You create a data.frame with columns: "day", "month", "year"
and "flow". 2) You create a time-series (ts) from "flow" and give the start date of the series when calling 'createlfobj'.

### Preparation

lfstat does not need to know the unit of the flow, but you might want it to appear in your plots. You can use `setlfunit` to define how units are labelled in your graphics. Examples are given in '?setlfunit'.

Please check for NA-values using `lfnacheck`, indices and plots are made as if series were complete. See the manual on how to deal with missing values and, if reasonable, use `lfnainterpolate`.

### Indices

Functions available `meanflow`, `Qxx`, `MAM` (mean annual minima), `BFI`, `recession` (recession constant), `streamdef` (Streamflow deficit), `tyears` (Extreme value - T-years event), `seasratio`, `seasindex` and `multistationsreport`.

### Plots

`hydrograph recessionplot` (Diagnosis for recession) `fdc` (Flow-duration-curve) `sbplot` (seasonal barchart) `seglenplot` (select recession length for recession) `streamdefplot` (Streamflow deficit) `rfa` (Regional frequency analysis) `dmcurve` (Double mass curve)

Author(s)

Daniel Koffler <daniel.koffler@boku.ac.at> and Gregor Laaha <gregor.laaha@boku.ac.at>

References


<table>
<thead>
<tr>
<th>BFI</th>
<th>Base Flow Index</th>
</tr>
</thead>
</table>

**Description**

Calculates the base flow index of an object of class 'lfobj'.

**Usage**

`BFI(lfobj, year = "any", breakdays = NULL, yearly = FALSE)`

**Arguments**

- `lfobj` : An object of class "lfobj"
- `year` : The year for which the BFI should be computed. If `hyearstart` != 1 the BFI is calculated for the hydrological year "any" means the whole series should be taken.
- `breakdays` : A vector of breakdays if the BFI should be calculated for different seasons.
- `yearly` : If TRUE, the BFI is calculated for each hydrological year separately.
Details

If breakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If more than two seasons are to be specified, a vector of all breakdays is needed.

Value

A length one vector giving the BFI for the whole series or the specified year. If yearly is true, a vector of the annual BFIs is returned. If breakdays are specified, the values are separated per season.

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

bfplot

Examples

data(ngaruroro)
BFI(ngaruroro)
BFI(ngaruroro, breakdays = c("01/11","01/05"))
BFI(ngaruroro, year = 1991)
bfplot(ngaruroro, year = 1991)

bfplot

Base Flow Plot

Description

Visualises the hydrograph versus the base flow hydrograph.

Usage

bfplot(lfobj,
    year = "any",
    col = "green",
    bfcol = "blue",
    ylog = FALSE)
createLfobj

Arguments

lfobj An object of class "lfobj"
year The hydrological year for which the BFI should be computed. If "any" the whole series is plotted.
col Color of Flow
bfcol Color of Baseflow
ylog Log y-axis?

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

BFI

Examples

data(ngaruroro)
#Plot starts in December, as ngaruroro's hyearstart = 12
bfplot(ngaruroro, year = 1991)

createLfobj Create an lfobj for further Low Flow Analysis

Description

Generic function for creating a low flow object (lfobj). Low flow objects can be created out of a time series of daily flow, a data.frame with columns "flow", "day", "month" and "year".

Usage

createLfobj(x, ...)

## S3 method for class 'data.frame'
createLfobj(x, hyearstart = 1, baseflow = TRUE,
            meta = list(), ...)

## S3 method for class 'ts'
createLfobj(x,
createlfobj(x, hyearstart = NULL, baseflow = NULL, meta = NULL,...)

Arguments

x 	An object out of which a lfobj should be created
hyearstart 	integer, which month should the hydrological year start?
baseflow 	logical, should the baseflow curve be calculated? Needed, if you want to apply 'bfplot' or 'BFI' later on.
meta 	A list of meta-information
startdate 	Startdate of the time-series
dateformat 	Format of the startdate
... 	Additional arguments depending on the method used.

Details

'hyearstart' defines the starting month of the hydrological year. If 'hyearstart' is greater than 6.5, the hydrological year starts earlier than the actual date, e.g. hyearstart = 10, then the 1st of October 2011 is part of the hydrological year 2012. If hyearstart = 4, then the 31st of March 2011 ist part of the hydrological year 2010.

Value

An object of class 'lfobj'.

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

readlfdata

Examples

#Creating a lfobj from a timeseries
#Some sample data:

somevalues <- rexp(365)
#Convert to time series:
time <- ts(somevalues)

# Let's say our data contains values from one hydrological year (Oct-Sep)
# starting on 1. Oct. 1992:
myriver <- createlfobj(time, startdate = "01/10/1992", hyearstart = 10)
# Add meta-data
createlfobj(myriver, meta = list(river = "myriver"))

dmcurve

**Description**

Calculates the double mass curve of two object of class 'lfobj'.

**Usage**

```r
dmcurve(x, y, year = "any", namex = substitute(x), namey = substitute(y),
        na.rm = TRUE)
```

**Arguments**

- `x`: An object of class "lfobj"
- `y`: An object of class "lfobj"
- `year`: The year for which the dmcurve should be calculated
- `namex`: character - Label of the x-Axis in the dmcurve
- `namey`: character - Label of the y-Axis in the dmcurve
- `na.rm`: Remove NAs?

**Author(s)**

Daniel Koffler and Gregor Laaha

**References**


**Examples**

```r
data(ngaruroro)
n1 <- subset(ngaruroro, year %in% 1985:1989)
n2 <- subset(ngaruroro, year %in% 1990:1995)
dmcurve(n1, n2, namex = "'Ngaruroro 1985 - 1989'", namey = "'Ngaruroro 1990 - 1995'")
```
**Description**

Plots the flow duration curve for a given lfojb.

**Usage**

```r
dec(lfojb, year = "any", breakdays = NULL, colors = TRUE, 
    xnorm = FALSE, ylog = TRUE, legend = TRUE, separate = FALSE, 
    ...)```

**Arguments**

- `lfojb` An object of class "lfojb"
- `year` numeric - The year for which the fdc should be computed. If hyearstart != 1 the BFI is calculated for the hydrological year! "any" means the whole series should be taken.
- `breakdays` A vector of breakdays if the BFI should be calculated for different seasons.
- `colors` logical - If breakdays are specified, should the different fdcs are displayed in different colors?
- `xnorm` logical - should the x-axis be normalised?
- `ylog` logical - The the logarithm of the y-axis?
- `legend` logical - Should a legend be plotted?
- `separate` logical - Should a separate plot be drawn for every season?
- `...` Graphical parameters handed to plot

**Details**

If breakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If more than two seasons are to be specified, a vector of all breakdays is needed.

**Value**

A vector of quantiles.

**Author(s)**

Daniel Koffler and Gregor Laaha

**References**

hydrograph

See Also

ecdf

Examples

data(ngaruroro)
fdc(ngaruroro, year = 1991)

Description

Plots the hydrograph for a given period.

Usage

hydrograph(lfobj, startdate = NULL, enddate = NULL, amin = FALSE, ...)

Arguments

lfobj An object of class "lfobj"
startdate Begin of hydrograph, date or hydrological year
enddate End of hydrograph, date or hydrological year
amin logical, mark annual minima?
... Additional arguments handed to "plot" - please note that some changes e.g. tick-
marks on x-axis are not possible

Details

Startdate and enddate can be NULL (first/last date in lfobj), a date in format "dd/mm/yyyy" (e.g.
"01/10/1971") or a year yyyy (e.g 1961).

Value

Plot of hydrograph

Author(s)

Daniel Koffler and Gregor Laaha

References

lfnacheck

**Description**

Looks for NAs in a lfobj.

**Usage**

```r
lfnacheck(lfobj)
```

**Arguments**

- `lfobj` An object of class "lfobj"

**Value**

A list with the total number of NAs, the percentage, the NAs for every year and the durations of NA-series.

**Author(s)**

Daniel Koffler and Gregor Laaha

**References**


**See Also**

- `bfplot`
Interpolate missing values

**Description**

If a lfobj contains missing values, the missing values are replaced by connecting the last available value before the break and the first after the break by a straight line.

**Usage**

```
lfnainterpolate(lfobj)
```

**Arguments**

- `lfobj` An object of class "lfobj"

**Value**

```
lfobj An object of class "lfobj"
with interpolated missing values
```

**Warning**

Check carefully in advance if interpolation is a reasonable choice for filling the hydrograph

**Author(s)**

Daniel Koffler and Gregor Laaha

**References**


**See Also**

`bfplot`
Examples

data(ngaruroro)

#Part of the ngaruroro series with missing data
hydrograph(ngaruroro, startdate = "1/7/1987", enddate = "1/9/1987", amin = FALSE)

ngaruroroint <- lfninterpolate(ngaruroro)

#The completed hydrograph
hydrograph(ngaruroroint, startdate = "1/7/1987", enddate = "1/9/1987", amin = FALSE)

<table>
<thead>
<tr>
<th>MAM</th>
<th>Mean Annual Minimum</th>
</tr>
</thead>
</table>

Description

Computes the Mean Annual Minimum (MAM-n) for any given n.

Usage

MAM(lfobj, n = 7, year = "any", breakdays = NULL, yearly = FALSE)

Arguments

- `lfobj`: An object of class "lfobj"
- `n`: Mean Annual minimum for n-days, e.g. n=7 computes MAM7
- `year`: The year for which the BFI should be computed. If hyearstart != 1 the BFI is calculated for the hydrological year! "any" means the whole series should be taken. If a vector of years is given, all this years are included in the calculation.
- `breakdays`: A vector of breakdays if the BFI should be calculated for different seasons.
- `yearly`: If TRUE, the BFI is calculated for each hydrological year separately.

Details

If breakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If more than two seasons are to be specified, a vector of all breakdays is needed.

Value

A length one vector giving the BFI for the whole series or the specified year. If yearly is true, a vector of the annual BFIs is returned. If breakdays are specified, separated values for every season are given.

Warning

At the moment there is no check for seasonal overlap. E.g. The MAM7 of 1991 and 1992 could take the same days for calculation if the are in n/2-days range. This problem could be avoided by choosing a "meaningfull" hyearstart and breakdays, usually dates out of the low flow seasons.
**meanflow**

**Note**

The annual minima can be calculated by setting `n=1` and `yearly = TRUE`.

**Author(s)**

Daniel Koffler and Gregor Laaha

**References**


**See Also**

`meanflow.Q95`

**Examples**

```r
data(ngaruroro)
MAM(ngaruroro)
MAM(ngaruroro, n=1) # Mean annual minimum
MAM(ngaruroro, breakdays = c("01/11","01/05"))
MAM(ngaruroro, year = 1991)
```

**meanflow** | **Mean flow**
---|---

**Description**

Calculates the meanflow of an object of class 'lfobj'.

**Usage**

```r
meanflow(lfobj, year = "any", monthly = FALSE, yearly = FALSE, breakdays = NULL, na.rm = TRUE)
```

**Arguments**

- `lfobj` An object of class 'lfobj'
- `year` The year for which the meanflow should be computed. If `yearstart != 1` the meanflow is calculated for the hydrological year! "any" means the whole series should be taken.
- `monthly` logical - Should the meanflow be calculated separately for every month?.
- `yearly` logical - If TRUE, the meanflow is calculated for each hydrological year separately.
- `breakdays` A vector of breakdays if the meanflow should be calculated for different seasons.
- `na.rm` Should missing values be ignored?
Details

If breakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If more than two seasons are to be specified, a vector of all breakdays is needed.

Value

A length one vector giving the meanflow for the whole series or the specified year. If yearly is true, a vector of the annual meanflows is returned. If breakdays are specified, the values are separated per season.

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

MAM

Examples

data(ngaruroro)
meanflow(ngaruroro)
meanflow(ngaruroro, breakdays = c("01/11","01/05"))
meanflow(ngaruroro, year = 1991)

Description

Calculates indices for several stations at once.

Usage

multistationsreport(...,indices = c("meanflow", "Q95", "MAM1", "MAM7", "MAM10", "MAM30", "MAM90", "baseflowindex", "recession"), recessionmethod = "MRC", recessionseglength = 7, recessionthreshold = 70, recessiontrimIRS = 0.1,lflist = NULL)
multistationsreport

Arguments

... Objects of class "lfobj"
indices A vector of indices to calculate
recessionmethod See recession
recessionseglength See recession
recessionthreshold See recession
recessiontrimIRS See recession
lflist Alternative give a list containing "lfobj"s.

Value

A data.frame containing the calculated indices.

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

meanflow, Q95,MAM,BFI,recession

Examples

data(ngaruroro)
multistationsreport(ngaruroro, indices = c("meanflow", "MAM7"))

seventies <- subset(ngaruroro, hyear %in% 1970:1979)
eighties <- subset(ngaruroro, hyear %in% 1980:1989)
nineties <- subset(ngaruroro, hyear %in% 1990:1999)
multistationsreport(seventies, eighties, nineties)
**Description**

This data set gives the streamflow records from 20/09/1963 to 31/12/2000. The data structure is a low flow object (lfobj) as used in the package lfstat. The rivers hydrological year starts with December.

**Usage**

```r
data(ngaruroro)
```

**Format**

A lfobj `createLfobj`

**Source**


**References**


---

**Qxx**

**Qxx, Q95, Q90, Q70**

**Description**

Calculates the quantiles of an object of class 'lfobj'.

**Usage**

```r
Qxx(lfobj, Qxx, year = "any", monthly = FALSE, yearly = FALSE, breakdays = NULL, na.rm = TRUE)
```

```r
Q95(lfobj, year = "any", monthly = FALSE, yearly = FALSE, breakdays = NULL, na.rm = TRUE)
```

```r
Q90(lfobj, year = "any", monthly = FALSE, yearly = FALSE, breakdays = NULL, na.rm = TRUE)
```

```r
Q70(lfobj, year = "any", monthly = FALSE, yearly = FALSE, breakdays = NULL, na.rm = TRUE)
```
Arguments

lfobj
An object of class "lfobj"

Qxx
The quantile to calculate, e.g. 70 would refer to Q70

year
The year for which the Q95 should be computed. If hyearstart != 1 the Q95 is calculated for the hydrological year! "any" means the whole series should be taken.

monthly
logical - Should the Q95 be calculated separately for every month?.

yearly
logical - If TRUE, the Q95 is calculated for each hydrological year separately.

breakdays
A vector of breakdays if the Q95 should be calculated for different seasons.

na.rm
Should NA's be ignored?

Details

If breakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If more than two seasons are to be specified, a vector of all breakdays is needed.

Value

A length one vector giving the Q95 for the whole series or the specified year. If yearly is true, a vector of the annual Q95s is returned. If breakdays are specified, the values are separated per season.

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

MAM

Examples

data(ngaruroro)
Q5(ngaruroro)
Q95(ngaruroro, breakdays = c("01/11","01/05"))
Q95(ngaruroro, year = 1991)
#Calculate Q99
Qxx(ngaruroro, Qxx = 99)
readlfdata  

*Reads data sheets*

**Description**

Reads data sheets of different formats directly as lfobjs.

**Usage**

```r
readlfdata(file, type = c("GRDC", "HZB", "LFU", "TU"), lfobj = TRUE, readmeta = TRUE,...)
```

**Arguments**

- **file**  
  The name of the file which the data are to be read from.

- **type**  
  The style of the sheet, currently the following formats are accepted: "GRDC", "HZB" (Austria), "LFU" (Germany, Bavaria), "TU" (Technical University Vienna)

- **lfobj**  
  logical, should a lfobj be created?

- **readmeta**  
  logical, should metainformation from data sheets be saved?

- **...**  
  Handed to createlfobj, could be "hyearstart", "baseflow" or "meta", if "readmeta" is FALSE

**Value**

A lfobj or data.frame depending on "lfobj".

**Note**

If you like other file formats (national standards) to be includes, send some examples with a remark how NAs are marked to the author

**Author(s)**

Daniel Koffler and Gregor Laaha

**References**


**See Also**

`createlfobj`
Examples

#Finding the sample file on your computer
path <- system.file("samplesheets/9104020.day", package = "lfstat")

grdc <- readlfdata(path, type = "GRDC", baseflow = FALSE)
#Some test...
head(grdc)

<table>
<thead>
<tr>
<th>recession</th>
<th>Recession Constant</th>
</tr>
</thead>
</table>

Description

Does recession analysis using either the MRC (Master recession curve) or IRS (individual recession segments) method.

Usage

recession(lfobj,
  method = c("MRC", "IRS"),
  seglength,
  threshold,
  peaklevel = 0.95,
  seasonbreakdays = NULL,
  thresbreaks = c("fixed", "monthly","seasonal"),
  thresbreakdays = NULL,
  plotMRC = TRUE,
  trimIRS = 0,
  na.rm = TRUE)

Arguments

- **lfobj**: An object of class "lfobj"
- **method**: "MRC" or "IRS"
- **seglength**: The length of the duration segments - see the WMO-manual and use seglenplot to choose a good value.
- **threshold**: The threshold level (70 means Q70)
- **peaklevel**: A level between 0 and 1 or a logical vector, see details.
- **seasonbreakdays**: A vector of breakdays. Needed if the recession constant should be calculated individually for different seasons, see details.
- **thresbreaks**: "fixed" uses a fixed threshold level, "monthly" calculates the threshold for every month separately, "seasonal" calculates thresholds for every season defined using "thresbreakdays".
- **thresbreakdays**: Needed if "thresbreaks = 'seasonal'" to define the periods for which separate thresholds should be calculated, see details.
plotMRC logical, if TRUE and "method = 'MRC'" a plot like figure 5.4 in the manual is given.

trimIRS Should a trimmed mean be used for calculating the IRS-constant? (0 means no, 0.1 means trim by 10 %)

na.rm Should NAs in the series be ignored?

Details

For recession analysis it is neccessary to define flood discharge peaks in the hydrograph. Peaklevel defines a day to be a discharge peak, if peaklevel * flow > flow[day before] and peaklevel * flow > flow[day after]. Use recessionplot to find a good level or hand a logical vector where TRUE means rainpeak.

If thresbreakdays or seasonbreakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If more than two seasons are to be specified, a vector of all breakdays is needed.

Value

The overall recession rate in days. If seasons are defined a rate for every season is calculated.

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

seglenplot, recessionplot

Examples

## Not run:
data(ngaruroro)
recession(ngaruroro,method = "MRC",seglen = 7,threshold = 70)

## End(Not run)
Description

Helps to define peak level of a lfobj and visualises recession periods.

Usage

```r
recessionplot(lfobj,
    peaklevel = 0.95,
    plot = TRUE,
    peakreturn = FALSE,
    thresplot = TRUE,
    threscol = "blue",
    threshold = 70,
    thresbreaks = c("fixed","monthly","seasonal"),
    thresbreakdays = c("01/06","01/10"),
    recessionperiod = TRUE,
    recessioncol = "darkblue",
    seglength = 7,
    ...
)
```

Arguments

- `lfobj` A object of class lfobj
- `peaklevel` A level between 0 and 1 or a logical vector, see details.
- `plot` Should a plot be made
- `peakreturn` Should a logical with rainpeaks be returned
- `thresplot` Should the threshold be plotted
- `threscol` Color of threshold in plot
- `threshold` Threshold level (70 refers to Q70)
- `thresbreaks` "fixed" uses a fixed threshold level, "monthly" calculates the threshold for every month separately, "seasonal" calculates thresholds for every season defined using "thresbreakdays".
- `thresbreakdays` Needed if "thresbreaks = 'seasonal'" to define the periods for which separate thresholds should be calculated, see details
- `recessionperiod` Should recession periods be marked
- `recessioncol` Color of recessionperiod marks
- `seglength` The minimum number of days to be marked as recession period
- `...` Further arguments handed to `hydrograph`. 
Details

For recession analysis it is necessary to define flood discharge peaks in the hydrograph. Peaklevel defines a day to be a discharge peak, if peaklevel * flow > flow[day before] and peaklevel * flow > flow[day after].

This function can be used to check different values of peaklevel.

Value

If peakreturn = TRUE: A logical vector giving rainpeaks as TRUE

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

recession

Examples

```r
## Not run:
data(ngaruroro)
#To few points identified as peak flood discharge
recessionplot(ngaruroro, peaklevel = .5, start = 1991, end = 1991)

#To many
recessionplot(ngaruroro, peaklevel = .999, start = 1991, end = 1991)

#Good choice?
recessionplot(ngaruroro, peaklevel = .92, start = 1991, end = 1991)

#Getting peakdays for 1991
peak <- recessionplot(ngaruroro, peaklevel = .92, plot = FALSE)
rain1991 <- subset(ngaruroro, subset = hyear == 1991 & peak, select = c(day, month, year))
## End(Not run)
```
Description

This function uses J.R.M. Hosking’s package produce an object of class "rfd", containing the specification of the regional frequency distribution.

Usage

rfa(Iflist, n = 7, event = 100, dist = c("wei","gev","ln3","gum","pe3"))

Arguments

lflist  A list of "lfobj"s
n       MAM-n is used (e.g. n=7 means MAM7)
event   A value for T, e.g. event = 100 means the 100 years extreme low flow event
dist    A vector of distribution to fit, the names are according to Hostking’s in his "lmom" package. Can be an of "wei", "gev", "ln3", "gum", "pe3".

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

lmom, lmomRFA

Examples

data(ngaruroro)

#Toy example to get some more "rivers"
seventies <- subset(ngaruroro, hyear %in% 1970:1979)
eighties <- subset(ngaruroro, hyear %in% 1980:1989)
nineties <- subset(ngaruroro, hyear %in% 1990:1999)
toyrfa <- rfa(list(seventies,eighties,nineties), n=3,dist = "gev")

#Now you can work on using Hosking's lmomRFA-package, e.g.
regquant(c(1/1000,1/100),toyrfa)
sitequant(1/100,toyrfa)
rfaplot  Regional Frequency Analysis

Description

This function uses J.R.M. Hosking's package lmom to produce a L-moment diagram.

Usage

rfaplot(lflist, n = 7,...)

Arguments

lflist  A list of "lfobj"s
n  MAM-n is used (e.g. n=7 means MAM7)
...  is passed to Hosking's function lmrd.

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

lmom, rfa

Examples

data(ngaruroro)

#Toy example to get some more "rivers"
seventies <- subset(ngaruroro, hyear %in% 1970:1979)
eighties <- subset(ngaruroro, hyear %in% 1980:1989)
nineties <- subset(ngaruroro, hyear %in% 1990:1999)

rfaplot(list(seventies,eighties,nineties), n=3)
sbplot

**Seasonal Barchart**

**Description**

Plots a seasonal barchart for daily streamflow data

**Usage**

```r
sbplot(lfobj, hyearorder = TRUE)
```

**Arguments**

- `lfobj`: A lfobj, as created with `createlfobj`
- `hyearorder`: logical, if TRUE the bars are plotted according to the hydrological year, if FALSE they start with January.

**Author(s)**

Daniel Koffler and Gregor Laaha

**References**


**See Also**

- `createlfobj`

**Examples**

```r
data(ngaruroro)
sbplot(ngaruroro)
# Starting with January
sbplot(ngaruroro, hyearorder = FALSE)
```
seasindex  

Seasonality Index

Description

Calculates the seasonality index.

Usage

seasindex(1fobj,  
  Q = 95,  
  na.rm = TRUE)

Arguments

1fobj  An object of class "lfobj"
Q  Which quantile to use (standard = Q95)
na.rm  Should missing values be ignored?

Value

A list describing the arrow

theta  Angle in radians
D  Julian Date
r  Length

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

seasindex

Examples

data(ngaruroro)  
# Start of the hydrological year (01/12) is taken as second breakday  
seasindex(ngaruroro)
seasratio  

**Seasonality Ratio**

**Description**
Calculates the seasonality ratio for two seasons.

**Usage**

```r
seasratio(lfobj, 
  breakdays, 
  Q = 95)
```

**Arguments**

- `lfobj`: An object of class "lfobj"
- `breakdays`: One or two dates defining the summer/winter season
- `Q`: Which quantile to use (standard = Q95)

**Details**
If breakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If other seasons are to be specified, a vector of two breakdays is needed.

**Value**
The seasonality ratio.

**Author(s)**
Daniel Koffler and Gregor Laaha

**References**

**See Also**
`seasindex`

**Examples**

```r
data(ngaruroro)
#Start of the hydrological year (01/12) is taken as second breakday
seasratio(ngaruroro, breakdays = "01/07")

#Two breakdays
seasratio(ngaruroro, breakdays = c("01/03","01/09"))
```
seglenplot  

_Barchart of recession length_

**Description**

Plots a barchart to find a good value for ‘seglength’ when using recession.

**Usage**

```r
seglenplot(lfobj,
    threslevel = 70,
    thresbreaks = c("fixed","monthly","seasonal"),
    thresbreakdays = NULL,
    rainpeaklevel = 0.95,
    na.rm = TRUE)
```

**Arguments**

- `lfobj`: An object of class "lfobj"
- `threslevel`: The threshold level (70 means Q70)
- `thresbreaks`: "fixed" uses a fixed threshold level, "monthly" calculates the threshold for every month separately, "seasonal" calculates thresholds for every season defined using "thresbreakdays".
- `thresbreakdays`: Needed if "thresbreaks = 'seasonal'" to define the periods for which separate thresholds should be calculated, see details.
- `rainpeaklevel`: A level between 0 and 1 or a logical vector, see details.
- `na.rm`: Should NAs in the series be ignored?

**Details**

For recession analysis it is neccessary to define flood discharge peaks (rainpeaks) in the hydrograph. Rainpeaklevel defines a day to be a discharge peak, if rainpeaklevel * flow > flow[day before] and rainpeaklevel * flow > flow[day after].

If thresbreakdays or seasonbreakdays is a single day, e.g. "01/06", the start of the hydrological year is taken as the second breakday. If more than two seasons are to be specified, a vector of all breakdays is needed.

**Value**

A barchart

**Warning**

Other then in the manual, we implemented a barchart instead of a histogram. To save space, empty bars are not plotted!
setlfunit

Author(s)
Daniel Koffler and Gregor Laaha

References

See Also
recession

Examples

```r
## Not run:
data(ngaruroro)
seglenplot(ngaruroro)
## End(Not run)
```

setlfunit

Define the unit to use in lf-plots

Description
Sets the option for the unit in plots.

Usage

```r
setlfunit(string = "")
```

Arguments

string String of the unit

Details
The unit string should be readable for the R-function expression, for common units see example below.

Warning
No calculation on data is done by setting this string.

Author(s)
Daniel Koffler and Gregor Laaha
References


Examples

data(ngaruroro)
#Default: no unit
bfplot(ngaruroro, year = 1991)

#The plot does not change, just the y-label does!
setlfunit("m^3/s")
bfplot(ngaruroro, year = 1991)

#Some possible labels:
setlfunit("m^3/s")
setlfunit("m^3/s\{-1\}")
setlfunit("\frac{m^3}{s}\{\text{a}\}"")
setlfunit("1/s")
setlfunit("1/s\{-1\}")
setlfunit("\frac{1}{s}\{\text{a}\}"")
setlfunit("m^3/s/km^2")
setlfunit("m^3/s\{-1\} \times km^2\{-2\}")
setlfunit("\frac{m^3}{s} \times km^2\{-2\}\{\text{a}\}"")
setlfunit("1/s\times km^2\{-2\}")
setlfunit("\frac{1}{s} \times km^2\{-2\}\{\text{a}\}"")
setlfunit("\frac{m^3}{s} \times km^2\{-2\}\{\text{a}\}"")

streamdef

Streamflow Deficite

Description

Calculates the streamflow deficite

Usage

streamdef(lfobj,
  pooling = c("none", "MA", "IT", "IC"),
  threslevel = 70,
  thresbreaks = c("fixed","monthly","daily","seasonal"),
  breakdays = c("01/06","01/10"),
  MADays = 7,
  tmin = 5,
  ILevel = 0.1,
  mindur = 0,
  minvol = 0,
  table = c("all", "volmax", "durmax"),
  na.rm = TRUE)
Arguments

- `lfobj`: An object of class "lfobj"
- `pooling`: The pooling procedure used, "MA" stands for moving average, "IT" is the inter-event time and "IC" is Lena Tallaksens interevent time and volume criterion.
- `threslevel`: The threshold level, 70 means that Q70 should be used as threshold
- `thresbreaks`: The periods for which seperated thresholds should be used, "fixed" uses a constant threshold, "monthly" uses monthly breaks, "daily" takes daily thresholdlevels. If "seasonal" is specified, you can enter the breakdays manually using "breakdays".
- `breakdays`: A vector of breakdays if thresbreaks = "seasonal". Please enter the breakdays using the format "
- `MAdays`: If pooling = "MA" this is the number of days that should be averaged
- `tmin`: Defines the number of days that low flow events must be seperatet within the "IT" or "IC" method.
- `IClevel`: The ratio between inter-event excess volume in the "IC" method
- `mindur`: The minimal duration of a low flow event in "IC" and "IT" method
- `minvol`: The minimal deficit in a low flow period in "IC" and "IT" method
- `table`: Should the output be a table of "all" deficit, "volmax" annual volume maxima or "durmax" annual duration maxima
- `na.rm`: Should NAs be removed?

Details

When method "MA" is applied, the first and last MAdays/2 are not averaged, their original value is taken instead!

Value

A data frame containing characteristics of all low flow periods.

- `d`: The duration of the low flow event
- `v`: The drought volume (negative Values, as it is a deficite)
- `mi`: The drought magnitude, i.e. the (positive) ratio between deficit volume and deficite duration
- `Qmin`: The minimum flow of the low flow period
- `startyear`: Year of the start of the low flow period
- `startmonth`: Month of the start of the low flow period
- `startday`: Day of the start of the low flow period

Please note that when using the "IT" method the end date of the low flow periode is not necessarily startdate + duration.

Author(s)

Daniel Koffler and Gregor Laaha
References


See Also

streamdefplot, createlfobj

Examples

data(ngaruoro)
# Full Table
streamdef(ngaruoro, pooling = "MA", MAdays = 6)
# Annual Volume-Maxima only
streamdef(ngaruoro, pooling = "MA", MAdays = 6, table = "volmax")

streamdefplot

Streamflow Deficite Plot

Description

Gives a plot for a given hydrological year that shows deficit duration, occurrence and volume.

Usage

streamdefplot(lfobj, year, threslevel = 70, thresbreaks = c("fixed", "monthly", "daily", "seasonal"), breakdays = c("01/06", "01/10"))

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>lfobj</td>
<td>An object of class &quot;lfobj&quot;</td>
</tr>
<tr>
<td>year</td>
<td>The hydrological year that should be plotted</td>
</tr>
<tr>
<td>threslevel</td>
<td>The threshold level, 70 means that Q70 should be used as threshold</td>
</tr>
<tr>
<td>thresbreaks</td>
<td>The periods for which separated thresholds should be used, &quot;fixed&quot; uses a constant threshold, &quot;monthly&quot; uses monthly breaks, &quot;daily&quot; takes daily threshold levels. If &quot;seasonal&quot; is specified, you can enter the breakdays manually using &quot;breakdays&quot;.</td>
</tr>
<tr>
<td>breakdays</td>
<td>A vector of breakdays if thresbreaks = &quot;seasonal&quot;. Please enter the breakdays using the format &quot;</td>
</tr>
</tbody>
</table>

Author(s)

Daniel Koffler and Gregor Laaha
tyears

References

See Also
streamdef

Examples

data(ngaruroro)
streamdefplot(ngaruroro, year = 1991)

Description
Fits a mixed extreme value distribution and estimates the T-Years event.

Usage

```r
tyyears(lfobj, 
ext = 100, 
n = 7, 
dist = c("wei","gev","ln3","gum","pe3"), 
ext = TRUE, 
zeta = NULL)
```

Arguments

- **lfobj**: An object of type "lfobj"
- **event**: A value for T, e.g. event = 100 means the 100 years extreme low flow event
- **n**: The n in the AM(n-day) series, e.g. n=7 the annual 7 day minima are predicted
- **dist**: A vector of distribution to fit, the names are according to Hostking’s in his "lmom" package. Use ?cdf... (... is the distribution-name, e.g. ?cdfwei) for more information.
- **legend**: logical, should R add a legend to the plot?
- **zeta**: Manually set the zeta parameter of the Weibull distribution

Details
According to paragraph 7.4.2 in the manual, we have to take care of censored series. The parameters/plots are always for G(x) in (7.4), the T-Years-Event is calculated for F(x)*. If a Weibull distribution is fitted and zeta takes a value smaller than 0 it is set to 0. If you want to specify zeta otherwise, use the zetawei argument!
Value

A list containing

- `T_Years_Event`: The expected T-Years event of all used distributions
- `pnull`: The estimated value for \( p_0 \), i.e. the estimated probability for 0 as AM(n) minimum.
- `parameters`: The parameters of the fitted distributions
- `lmom`: The estimated L-Moments

Author(s)

Daniel Koffler and Gregor Laaha

References


See Also

`lmom, cdfwei`

Examples

data(ngaruroro)

#TYEARS EXAMPLE!!!
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