Goodness-of-fit Measures to Compare Observed and Simulated Values with hydroGOF

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version 0.2, 11-Mar-2020

1 Installation

Installing hydroGOF:

```r
install.packages("hydroGOF")
```

2 Setting up the environment

- Loading the `hydroGOF` library, which contains data and functions used in this analysis.
  ```r
  library(hydroGOF)
  ```

- Loading observed streamflows of the Ega River (Spain), with daily data from 1961-Jan-01 up to 1970-Dec-31
  ```r
  require(zoo)
  data(EgaEnEstellaQts)
  obs <- EgaEnEstellaQts
  ```

- Generating a simulated daily time series, initially equal to the observed values (simulated values are usually read from the output files of the hydrological model)
  ```r
  sim <- obs
  ```

- Computing the numeric goodness-of-fit measures for the “best” (unattainable) case
  ```r
  gof(sim=sim, obs=obs)
  ```

```
##   [,1]
## ME  0
## MAE 0
## MSE 0
## RMSE 0
## NRMSE % 0
## PBIAS % 0
## RSR 0
## rSD 1
## NSE 1
## mNSE 1
```

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Randomly changing the first 2000 elements of 'sim', by using a normal distribution with mean 10 and standard deviation equal to 1 (default of 'rnorm').

\[
\]

Plotting the graphical comparison of 'obs' against 'sim', along with the numeric goodness-of-fit measures for the daily and monthly time series

\[
\text{ggof}(sim=sim, obs=obs, ftype="dm", FUN=\text{mean})
\]

2.1 Removing warm-up period

Using the first two years (1961-1962) as warm-up period, and removing the corresponding observed and simulated values from the computation of the goodness-of-fit measures:

\[
\text{ggof}(sim=sim, obs=obs, ftype="dm", FUN=\text{mean}, cal.ini="1963-01-01")
\]
Verifying the goodness-of-fit measures for the daily values after removing the warm-up period:

```
sim <- window(sim, start=as.Date("1963-01-01"))
obs <- window(obs, start=as.Date("1963-01-01"))
gof(sim, obs)
```

```
## [,1]
## ME 4.36
## MAE 4.36
## MSE 44.20
## RMSE 6.65
## NRMSE % 36.50
## PBIAS % 29.30
## RSR 0.36
## rSD 1.04
## NSE 0.87
## mNSE 0.63
## rNSe -0.52
## d 0.97
## md 0.81
## rd 0.64
## cp 0.44
## r 0.96
## R2 0.93
## bR2 0.83
## KGE 0.70
## VE 0.71
```
2.2 Analysis of the residuals

- Computing the daily residuals (even if this is a dummy example, it is enough for illustrating the capability)

```r
r <- sim-obs
```

- Summarizing and plotting the residuals (it requires the hydroTSM package):

```r
library(hydroTSM)

## Loading required package: xts

smy(r)
```

```
## Index r
## Min. 1963-01-01 0.0000
## 1st Qu. 1964-12-31 0.0000
## Median 1966-12-31 0.0000
## Mean 1966-12-31 4.3610
## 3rd Qu. 1968-12-30 9.8300
## Max. 1970-12-31 13.4500
## IQR <NA> 9.8298
## sd <NA> 5.0187
## cv <NA> 1.1508
## Skewness <NA> 0.3159
## Kurtosis <NA> -1.8315
## NA's <NA> 2.0000
## n <NA> 2922.0000
```

# daily, monthly and annual plots, boxplots and histograms

```r
hydroplot(r, FUN=mean)
```

```r
```
Seasonal plots and boxplots

# daily, monthly and annual plots, boxplots and histograms
hydroplot(r, FUN=mean, pfreq="seasonal")
3 Software details

This tutorial was built under:

## [1] "x86_64-pc-linux-gnu (64-bit)"
## [1] "R Under development (unstable) (2020-03-11 r77927)"
## [1] "hydroGOF 0.4-0"

4 Version history

- v0.2: Mar-2020
- v0.1: Aug 2011