Package 'FloodFreqPlot'

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Version 0.1.0

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Title Flood Probability Plotting and Graphical Frequency Analysis

Depends R (>= 3.5.0)

Imports stats, graphics, grDevices

Description Plotting flood quantiles and their corresponding probabilities (return periods) on the probability papers.
The details of relevant methods are available in Chow et al (1988, ISBN: 007070242X, 9780070702424), and
Bobee and Ashkar (1991, ISBN: 0918334683, 9780918334688).

License GPL (>= 3)

LazyData yes

Encoding UTF-8

RoxygenNote 7.1.2

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NeedsCompilation no

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R topics documented:

`FloodFreqPlot-package` *A package for flood frequency analysis by a graphical method*

Description

The flood data are plotted on an appropriate probability paper that linearizes the cumulative distribution function. Then the plotted flood data are fitted with a straight line for interpolation and extrapolation purposes.

`AH_Tab12_1_1` *Annual maximum discharges of the Guadalupe River near Victoria, Texas, 1935-1978.*

Description

A dataset containing annual maximum discharges (in cfs) of the Guadalupe River near Victoria, Texas, during 1935-1978, in cfs extracted from TABLE 12.1.1 of "Applied Hydrology" (Chow et al., 1987).

Format

A data frame with 44 rows and 1 variable:

Q_cfs annual maximum discharges in cfs ...

Source

Chow, V. T., Maidment, D. R., & Mays, L. W. (1988). *Applied Hydrology*. McGraw-Hill, New York, U. S.

AH_Tab12_2_1 *Annual maximum 10-minute rainfall at Chicago, Illinois, 1913-1947.*

Description

A dataset containing annual maximum 10-minute rainfall (in inches) at Chicago, Illinois, during 1913-1947 extracted from TABLE 12.2.1 of "Applied Hydrology" (Chow et al., 1987).

Format

A data frame with 35 rows and 1 variable:

PMax10min_in annual maximum 10-minute rainfall in inches ...

Source

Chow, V. T., Maidment, D. R., & Mays, L. W. (1988). Applied Hydrology. McGraw-Hill, New York, U. S.

B17C_Tab10_10 *U.S. Geological Survey gage 01614000 Back Creek near Jones Springs, West Virginia annual peak-flow record during 1929-2012*

Description

A dataset containing the U.S. Geological Survey gage 01614000 Back Creek near Jones Springs, West Virginia annual peak-flow record consisting of 56 peaks during 1929-2012, including the 1936 historical flood, extracted from Table 10.10 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 56 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Details

This table contains the date of the annual peak recorded at the gage, the water year of the annual peak, and the corresponding annual peak in cubic feet per second (ft3/s).

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

B17C_Tab10_14 *U.S. Geological Survey gage 07099500 (and others) Arkansas River annual peak-flow record during 1864-1976*

Description

A dataset containing the U.S. Geological Survey gage 07099500 (and others) Arkansas River annual peak-flow record consisting of 85 peaks from 1864 to 1976 extracted from Table 10.14 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 85 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Details

This table contains the water year of the annual peak and the corresponding annual peak in cubic feet per second (ft3/s).

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

B17C_Tab10_18 *U.S. Geological Survey gage 05489490 Bear Creek at Ottumwa, Iowa annual peak-flow record during 1965-2014*

Description

A dataset containing the U.S. Geological Survey gage 05489490 Bear Creek at Ottumwa, Iowa annual peak-flow record consisting of 49 peaks from 1965 to 2014 extracted from Table 10.18 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 50 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Details

This table contains the date of the annual peak recorded at the gage, the water year of the annual peak, and the corresponding annual peak in cubic feet per second (ft3/s).

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

`B17C_Tab10_2` *U.S. Geological Survey gage 01134500 Moose River at Victory, Vermont annual peak-flow record during 1947-2014*

Description

A dataset containing the U.S. Geological Survey gage 01134500 Moose River at Victory, Vermont annual peak-flow record consisting of 68 peaks from 1947 to 2014 extracted from Table 10.2 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 68 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Details

This table contains the date of the annual peak recorded at the gage, the water year of the annual peak, and the corresponding annual peak in cubic feet per second (ft3/s).

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

`B17C_Tab10_22` *U.S. Geological Survey gage 09480000 Santa Cruz River near Lochiel, Arizona annual peak-flow record during 1949 -2013*

Description

A dataset containing the U.S. Geological Survey gage 09480000 Santa Cruz River near Lochiel, Arizona annual peak-flow record consisting of 65 peaks from 1949 to 2013 extracted from Table 10.18 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 65 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Details

This table contains the date of the annual peak recorded at the gage, the water year of the annual peak, and the corresponding annual peak in cubic feet per second (ft3/s).

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

`B17C_Tab10_6` *U.S. Geological Survey gage 11274500 Orestimba Creek near Newman, California annual peak-flow record during 1932-2013*

Description

A dataset containing the U.S. Geological Survey gage 11274500 Orestimba Creek near Newman, California annual peak-flow record consisting of 82 peaks from 1932 to 2013 extracted from Table 10.6 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 82 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Details

This table contains the date of the annual peak recorded at the gage, the water year of the annual peak, and the corresponding annual peak in cubic feet per second (ft3/s).

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

B17C_Tab8_1 *Observed annual peak data for the Etowah River and Suwanee Creek from 1985-2004*

Description

A dataset containing the summary of concurrent observed annual peak data for the Etowah River and Suwanee Creek from 1985-2004 extracted from Table 8.1 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 20 rows and 2 variables:

Q_peak_Etowa_River_cfs name of the crop

Q_peak_Suwanee_Creek_cfs the crop coefficient in the growth initial stage

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

B17C_Tab8_2 *MOVE extended record for 13 years (1972-1984) for Suwanee Creek at Suwanee, Georgia*

Description

A dataset containing the MOVE extended record for 13 years (1972-1984) for Suwanee Creek at Suwanee, Georgia (station 02334885) extracted from Table 8.2 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 13 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

B17C_Tab8_3 — *Flood records for 93 years (1892-1984) for the Etowah River at Canton, Georgia*

Description

A dataset containing the flood records for 93 years (1892-1984) for the Etowah River at Canton, Georgia (station 02335000) extracted from Table 8.3 in "Guidelines for determining flood flow frequency - Bulletin 17C" (England et al., 2019)

Format

A data frame with 93 rows and 1 variable:

Q_peak_cfs peak flows in cfs

Source

England, J. F., Jr., Cohn, T. A., Faber, B. A., Stedinger, J. R., Thomas, W. O., Jr., Veilleux, A. G., Kiang, J. E., & Mason, R. R., Jr. (2019). Guidelines for determining flood flow frequency - Bulletin 17C. U.S. Geological Survey.

Harricana — *Maximum annual peak discharge values, obseved at Harricana River at Amos*

Description

A dataset containing the Maximum annual peak discharge values in cubic meter per second (cms), observed at Harricana River at Amos (Quebec, Canada) as displayed by the program HFA extracted from Table 1.2 in "The Gamma Family and Derived Distributions Applied in Hydrology" (Bobee and Ashkar, 1991).

Format

A data frame with 72 rows and 1 variable:

Observation peak flows

Source

Bobee, B. & Ashkar, F. (1991). *The Gamma Family and Derived Distributions Applied in Hydrology*. Water Resources Publications.

PlotPos *Plotting Position Probability*

Description

PlotPos returns the empirical probability values corresponding to the observed data of hydrological extreme events as a vector of numerics.

Usage

```
PlotPos(data_obs, PP)
```

Arguments

data_obs	A vector, data frame or matrix containing observed data or flood quantiles.
PP	A character string that determines the empirical formula used to calculate the probability. The formula can be chosen from the list: "Blom", "Chegodayev", "California" "Gringorten", "Hazen", "Tukey", and "Weibull".

Details

This is a function to calculate the emprical probability values assigned to the observed data of hydrological extreme events to be plotted.

Value

The function returns the probabilities assigned to the observed data as a vector of numerics.

Reference

Chow, V. T., Maidment, D. R., & Mays, L. W. (1988). *Applied Hydrology*. McGraw-Hill, New York, U.S.

See Also

ProbPlot for graphical frequency analysis.

Examples

```
# First Example
data('Harricana')
PlotPos(data_obs = Harricana, PP = 'Weibull')

# Second Example
data('B17C_Tab8_1')
PlotPos(data_obs = B17C_Tab8_1, PP = 'Cunnane')
```

ProbPlot *Flood Probability Plotting*

Description

ProbPlot checks that a probability distribution fits a set of flood data.

Usage

```
ProbPlot(
  data_obs,
  probs = NULL,
  PP = NULL,
  dist = NULL,
  T_rp = NULL,
  beta_CL = NULL,
  T_lim = NULL,
  Q_lim = NULL,
  main_title = NULL,
  x_lab = NULL,
  y_lab = NULL,
  Pcol = "black",
  Ppch = 1,
  Pcex = 1,
  Lcol = "blue",
  Lty = 1,
  Lwd = 1.5,
  CPlot = TRUE,
  CLcol = "red",
  CLty = 2,
  CLwd = 1.5,
  QTcol = "green",
  QTpch = 15,
  QTcex = 1.5,
  GumbRV = FALSE,
  P3SkewCheck = TRUE
)
```

Arguments

data_obs	A vector, data frame or matrix containing observed data or flood quantiles.
probs	Optional. The vector of plotting position probability values corresponding to the quantiles. If probs = NULL, then a Weibull plotting position formula is used to calculate probability values for quantiles.
PP	Optional. A character string that represents the plotting position formula used to calculate the empirical probability. The formula can be chosen from the list:

	"Blom", "California_1", "California_2", "Chegodayev", "Gringorten", "Hazen", "Tukey", and "Weibull". If PP = NULL, then PP = 'Weibull'.
dist	Optional. A string that represents CDF and it can be 'Norm' for Normal distribution, 'LNorm' for Log-Normal distribution, 'Gumb' for Gumbel distribution, 'Pea3' for Pearson type III distribution, and 'LPea3' for Log-Pearson type III distribution. If dist = NULL, then dist = 'Norm'.
T_rp	Optional. A numeric vector including the return periods of interest for the flood quantile estimation.
beta_CL	Optional. A numeric scalar that represents the confidence level for calculating and plotting the confidence limits (bounds). If beta_CL = NULL, then beta_CL = 0.95. It means that the significance level is equal to 0.05.
T_lim	Optional. A two-member numeric vector including the lower and upper return period limits determining the horizontal (x) axis range.
Q_lim	Optional. A two-member numeric vector including the lower and upper limits determining the vertical (y) axis range to show quantile values.
main_title	Optional. A character string representing the main title of the plot. The default title denotes the name of the theoretical probability distribution chosen to fit the data.
x_lab	Optional. A character string representing the label of horizontal axis. The default label of the axis is F(x) = P(X <= x).
y_lab	Optional. A character string representing the label of vertical axis. The default label of the axis is "Quantile".
Pcol	Optional. A specification for the observed flood quantile points color. Defaults to "black".
Ppch	Optional. Either an integer specifying a symbol or a single character to be used as the default in plotting observed flood quantile points. See points for possible values and their interpretation. Defaults to 1.
Pcex	Optional. A numerical value giving the amount by which plotting point symbols should be magnified relative to the default. Defaults to 1.
Lcol	Optional. A specification for the theoretical probability line color. Defaults to "blue".
Lty	Optional. The theoretical probability line type. Line types can either be specified as an integer (0=blank, 1=solid (default), 2=dashed, 3=dotted, 4=dotdash, 5=longdash, 6=twodash) or as one of the character strings "blank", "solid", "dashed", "dotted", "dotdash", "longdash", or "twodash", where "blank" uses 'invisible lines' (i.e., does not draw them). Defaults to 1.
Lwd	Optional. The theoretical probability line width, a positive number, defaulting to 1.5.
CPlot	Logical. If CPlot = TRUE, the confidence limits (bounds) are plotted. Defaults to TRUE.
CLcol	Optional. A specification for the confidence limits (bounds) color. Defaults to "red".

CLty	Optional. The confidence limits (bounds) line type. Line types can either be specified as an integer (0=blank, 1=solid (default), 2=dashed, 3=dotted, 4=dotdash, 5=longdash, 6=twodash) or as one of the character strings "blank", "solid", "dashed", "dotted", "dotdash", "longdash", or "twodash", where "blank" uses 'invisible lines' (i.e., does not draw them). Defaults to 1.
CLwd	Optional. The confidence limits (bounds) line width, a positive number, defaulting to 1.5.
QTcol	Optional. A specification for the T-year flood quantile estimate point color. Defaults to "green".
QTpch	Optional. Either an integer specifying a symbol or a single character to be used as the default in plotting the T-year flood quantile estimate points. See points for possible values and their interpretation. Defaults to 15.
QTcex	Optional. A numerical value giving the amount by which the T-year flood quantile estimate point symbols should be magnified. Defaults to 1.5.
GumbRV	Logical. If dist = 'Gumb' and GumbRV = 'TRUE', an extra horizontal axis is plotted to show Reduced Variable values.
P3SkewCheck	Logical. If P3SkewCheck = 'TRUE' (default), the skewness of data is checked and if the coefficient of skewness is greater than 2.5, the confidence limits are not plotted for some data in the left tail of the dataset.

Details

This is a function for frequency analysis by a graphical method. The flood data are plotted on an appropriate probability paper that linearizes the cumulative distribution function. Then the plotted flood data are fitted with a straight line for interpolation and extrapolation purposes. If probs = NULL, then a Weibull plotting position formula is used to calculate probability values for quantiles. If PP = NULL, then a Weibull plotting position formula is used to calculate the probabilities corresponding to the quantiles. If dist = NULL, then Normal distribution is used as the default frequency distribution. It should be noted that the distribution parameters are estimated by Method Of Moments (MOM). If beta_CL = NULL, then the confidence level is considered equal to 0.95 (that means the significance level is equal to 1-0.95=0.05).

Value

The function returns a graph including the plotted flood data and the fitted distribution and the confidence limits (bounds). Also, it returns and shows the flood quantile estimates corresponding to the return period(s) T_rp.

See Also

PlotPos for the plotting position probability.

Examples

```
# First Example
data('Harricana')
ProbPlot(data_obs = Harricana, PP = 'Cunnane', dist = 'LPea3', T_rp = c(100, 1000))
```

```
# Second Example
data('AH_Tab12_1_1')
ProbPlot(data_obs = AH_Tab12_1_1, PP = 'Weibull', dist = 'Gumb', T_rp = 250, T_lim = c(2, 1000))
```

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