

# EXTREME VALUE ANALYSIS PACKAGES

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## R software package for Extreme Value Analysis (CRAN packages)

### Univariate Extreme Value Theory:

#### **Block Maxima approach:**

evd; evmix; evdbayes; evir; extRemes; extremeStat; fExtremes; lmom; lmomRFA; texmex; ismev; mev; evt0

#### **Peak-Over-Threshold by GPD approach:**

evd; evmix; evdbayes; extremefit; extRemes; extremeStat; fExtremes; lmom; lmomRFA; texmex; POT; ismev; mev; QRM ;climextRemes ; evt0

#### **Extremal index estimation approach:**

evd; evmix; evdbayes; evir; extRemes; fExtremes; mev; evt0; ExtremeBounds; eventstudies; futureheatwaves; ifstat; MCMC4Extremes; NHPoisson; PerformanceAnalytics; Renext; tolerance

#### **Regression models:**

VGAM; ismev; VaRES; bgeva; EXRQ

#### **Copula approach:**

copula; fCopulae

### Bivariate Extreme Value Theory:

#### **Block Maxima approach:**

Evd; evmix; evt0

#### **Peak-Over-Threshold by GPD approach:**

evd; evmix; extremefit; POT; climextRemes; evt0; mvPot

#### **Tail dependence coefficient approach:**

RTDE

### Multivariate Extreme Value Theory:

#### **Block Maxima approach:**

lmomco; lmom; SpatialExtremes; evt0

#### **Peak-Over-Threshold by GPD approach:**

lmomco; SpatialExtremes; texmex; climextRemes; evt0; mvPot

#### **Copula approach:**

copula; SpatialExtremes; fCopulae; hkevp

#### **Classical graphics:**

POT; evir; extremefit; QRM; ReIns; evd; ismev; texmex; QRM; RTDE; SpatialExtremes; EnvStats

## List of Extreme Value Analysis (CRAN packages)

**bgeva:** Binary Generalized Extreme Value Additive Models

**Author:** Giampiero Marra, Raffaella Calabrese and Silvia Angela Osmetti (2015).

**R package version:** 0.3

<https://cran.r-project.org/web/packages/bgeva/index.html>

**Description:** Routine for fitting regression models for binary rare events with linear and nonlinear covariate effects when using the quantile function of the Generalized Extreme Value random variable.

**copula:** Multivariate Dependence with Copulas

**Authors:** Marius Hofert, Ivan Kojadinovic, Martin Maechler, and Jun Yan (2017)

**R package version:** 0.999-16

<https://cran.r-project.org/web/packages/copula/index.html>

**Description:** Classes (S4) of commonly used elliptical, Archimedean, extreme value and some more copula families. Methods for density, distribution, random number generation, bivariate dependence measures, perspective and contour plots. Fitting copula models including variance estimates. Independence and serial (univariate and multivariate) independence tests, and other copula related tests. Empirical copula and multivariate CDF. Goodness-of-fit tests for copulas based on multipliers, the parametric bootstrap with several transformation options.

**climextRemes:** Tools for Analyzing Climate Extremes

**Author:** Christopher Paciorek (2016)

**R package version:** 0.1.2

<https://cran.r-project.org/web/packages/climextRemes/index.html>

**Description:** Functions for fitting GEV and POT (via point process fitting) models for extremes in climate data, providing return values, return probabilities, and return periods for stationary and nonstationary models. Also provides differences in return values and differences in log return probabilities for contrasts of covariate values. Functions for estimating risk ratios for event attribution analyses, including uncertainty. Under the hood, many of the functions use functions from extRemes, including for fitting the statistical models.

**evir:** Extreme Values in R

**Author:** Bernhard Pfaff, Alexander McNeil, Alec Stephenson (2012)

**R package version:** 1.7-3

<https://cran.r-project.org/web/packages/evir/index.html>

**Description:** Functions for extreme value theory, which may be divided into the following groups; exploratory data analysis, block maxima, peaks over thresholds (univariate and bivariate), point processes, gev/gpd distributions.

**EXRQ:** Extreme Regression of Quantiles

**Author:** Huixia Judy Wang (2016)

**R package version:** 1.0

<https://cran.r-project.org/web/packages/EXRQ/index.html>

**Description:** Estimation for high conditional quantiles based on quantile regression.

**extremeStat:** Extreme Value Statistics and Quantile Estimation

**Author:** Berry Boessenkool (2017)

**R package version:** 1.3.0

<https://cran.r-project.org/web/packages/extremeStat/index.html>

**Description:** Code to fit, plot and compare several (extreme value) distribution functions. Can also compute (truncated) distribution quantile estimates and draw a plot with return periods on a linear scale.

**EnvStats:** Package for Environmental Statistics, Including US EPA Guidance

**Authors:** Steven P. Millard (2017).

**R package version:** 2.2.1

<https://cran.r-project.org/web/packages/EnvStats/index.html>

**Description:** Graphical and statistical analyses of environmental data, with focus on analyzing chemical concentrations and physical parameters, usually in the context of mandated environmental monitoring. Major environmental statistical methods found in the literature and regulatory guidance documents, with extensive help that explains what these methods do, how to use them, and where to find them in the literature. Also can estimate parameters, quantiles and etc of a Generalized Extreme Value Distribution.

**evd:** Functions for Extreme Value Distributions

**Authors:** Alec Stephenson (2015)

**R package version:** 2.3-2

<https://cran.r-project.org/web/packages/evd/index.html>

**Description:** Extends simulation, distribution, quantile and density functions to univariate and multivariate parametric extreme value distributions, and provides fitting functions which calculate maximum likelihood estimates for univariate and bivariate maxima models, and for univariate and bivariate threshold models.

**evmix:** Extreme Value Mixture Modelling, Threshold Estimation and Boundary Corrected Kernel Density Estimation

**Authors:** Carl Scarrott and Yang Hu (2015).

**R package version:** 0.2-6

<https://cran.r-project.org/web/packages/evmix/index.html>

**Description:** The usual distribution functions, maximum likelihood inference and model diagnostics for univariate stationary extreme value mixture models are provided. Kernel density estimation including various boundary corrected kernel density estimation methods and a wide choice of kernels, with cross-validation likelihood based bandwidth estimator. Reasonable consistency with the base functions in the 'evd' package is provided, so that users can safely interchange most code.

**evt0:** Mean of order  $p$ , peaks over random threshold Hill and high quantile estimates.

**Author:** B G Manjunath and Frederico Caeiro; guidance from Prof. M. Ivette Gomes and Prof. M. Isabel Fraga Alves (2013).

**R package version:** 1.1-3

<https://cran.r-project.org/web/packages/evt0/index.html>

**Description:** Computes extreme value index (EVI) estimate for heavy tailed models by Mean of order  $p$  (MOP) and peaks over random threshold (PORT) Hill methodologies. Besides, also computes moment, generalised Hill and mixed moment estimates for EVI. Compute high quantile or value-at-risk (VaR) based on above EVI estimates.

**extRemes:** Extreme Value Analysis

**Authors:** Eric Gilleland (2016)

**R package version:** 2.0-8

<https://cran.r-project.org/web/packages/extRemes/index.html>

**Description:** extRemes is a suite of functions for carrying out analyses on the extreme values of a process of interest; be they block maxima over long blocks or excesses over a high threshold.

**ExtremeBounds:** Extreme Bounds Analysis (EBA)

**Authors:** Marek Hlavac (2016)

**R package version:** 0.1.5.2

<https://cran.r-project.org/web/packages/ExtremeBounds/index.html>

**Description:** An implementation of Extreme Bounds Analysis (EBA), a global sensitivity analysis that examines the robustness of determinants in regression models. The package supports both Leamer's and Sala-i-Martin's versions of EBA, and allows users to customize all aspects of the analysis.

**extremefit:** Estimation of Extreme Conditional Quantiles and Probabilities

**Author:** Gilles Durrieu, Ion Grama, Kevin Jaunatre, Quang-Khoai Pham, Jean-Marie Tricot (2016).

**R package version:** 0.2.0

<https://cran.r-project.org/web/packages/extremefit/index.html>

**Description:** Extreme value theory, nonparametric kernel estimation, tail conditional probabilities, extreme conditional quantile, adaptive estimation, quantile regression, survival probabilities.

**eventstudies:** Event study and extreme event analysis

**Author:** Ajay Shah, Vimal Balasubramaniam, Vikram Bahure (2013)

**R package version:** 1.1

<https://cran.r-project.org/web/packages/eventstudies/index.html>

**Description:** Implementation of short and long term event study methodology.

**evdbayes:** Bayesian Analysis in Extreme Value Theory

**Author:** Alec Stephenson and Mathieu Ribatet (2014)

**R package version:** 1.1-1

<https://cran.r-project.org/web/packages/evdbayes/index.html>

**Description:** Provides functions for the bayesian analysis of extreme value models, using MCMC methods.

**fCopulae:** Rmetrics - Bivariate Dependence Structures with Copulae

**Authors:** Rmetrics Core Team, Diethelm Wuertz, Tobias Setz, and Yohan Chalabi (2014)

**R package version:** 3011.81

<https://cran.r-project.org/web/packages/fCopulae/index.html>

**Description:** The Rmetrics fCopulae package is a collection of functions to manage, to investigate and to analyse bivariate financial returns by Copulae. Included are the families of Archimedean, Elliptical, Extreme Value, and Empirical Copulae.

**fExtremes:** Rmetrics - Extreme Financial Market Data

**Authors:** Diethelm Wuertz and many others (2013).

**R package version:** 3010.81

<https://cran.r-project.org/web/packages/fExtremes/index.html>

**Description:** A collection and description of functions for data preprocessing of extreme values. This includes tools to separate data beyond a threshold value, to compute blockwise data like block maxima, and to decluster point process data.

**futureheatwaves:** Find, Characterize, and Explore Extreme Events in Climate Projections

**Authors:** Brooke Anderson, Colin Eason, Elizabeth Barnes (2016).

**R package version:** 1.0.3

<https://cran.r-project.org/web/packages/futureheatwaves/index.html>

**Description:** Inputs a directory of climate projection files and, for each, identifies and characterizes heat waves for specified study locations. The definition used to identify heat waves can be customized. Heat wave characterizations include several metrics of heat wave length, intensity, and timing in the year. The heat waves that are identified can be explored using a function to apply user-created functions across all generated heat wave files.

**hkevp:** Spatial Extreme Value Analysis with the Hierarchical Model of Reich and Shaby

**Author:** Quentin Seville (2016)

**R package version:** 1.1.4

<https://cran.r-project.org/web/packages/hkevp/index.html>

**Description:** Several procedures around a particular hierarchical model for extreme value: the HKEVP of Reich and Shaby (2012). Simulation, estimation and spatial extrapolation of this model are available for extreme value data.

**lfstat:** Calculation of Low Flow Statistics for Daily Stream Flow Data

**Authors:** Daniel Koffler, Tobias Gauster and Gregor Laaha (2016).

**R package version:** 0.9.4

<https://cran.rstudio.com/web/packages/lfstat/index.html>

**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 packages gives functions to compute the described statistics and produce plots similar to the one in the manual.

**lmom:** L-moments

**Authors:** J. R. M. Hosking (2015)

**R package version:** 2.5

<https://cran.r-project.org/web/packages/lmom/index.html>

**Description:** Functions related to L-moments: computation of L-moments and trimmed L-moments of distributions and data samples; parameter estimation; L-moment ratio diagram; plot vs. quantiles of an extreme-value distribution.

**lmomco:** L-Moments, Censored L-Moments, Trimmed L-Moments, L-Comoments, and Many Distributions.

**Author:** William Asquith (2016)

**R package version:** 2.2.5

<https://cran.r-project.org/web/packages/lmomco/index.html>

**Description:** Extensive functions for L-moments (LMs) and probability-weighted moments(PWMs), parameter estimation for distributions, LM computation for distributions, and Lmoment ratio diagrams.

**lmomRFA: Regional frequency analysis using L-moments**

**Author:** J. R. M. Hosking (2015)

**R package version:** 3.0-1

<https://cran.r-project.org/web/packages/lmomRFA/index.html>

**Description:** Functions for regional frequency analysis using the methods of J. R. M. Hosking and J. R. Wallis (1997), "Regional frequency analysis: an approach based on L-moments".

**ismev:** An Introduction to Statistical Modeling of Extreme Values

**Author:** Original S functions written by Janet E. Heffernan with R port and R documentation provided by Alec G. Stephenson. (2016)

**R package version:** 1.41

<https://cran.r-project.org/web/packages/ismev/index.html>

**Description:** Functions to support the computations carried out in 'An Introduction to Statistical Modeling of Extreme Values' by Stuart Coles. The functions may be divided into the following groups; maxima/minima, order statistics, peaks over thresholds and point processes.

**MCMC4Extremes:** Posterior Distribution of Extreme Value Models in R

**Author:** Fernando Ferraz do Nascimento, Wyara Vanesa Moura e Silva (2016).

**R package version:** 1.1

<https://cran.r-project.org/web/packages/MCMC4Extremes/index.html>

**Description:** Provides some function to perform posterior estimation for some distribution, with emphasis to extreme value distributions. It contains some extreme datasets, and functions that perform the runs of posterior points of the GPD and GEV distribution. The package calculate some important extreme measures like return level for each t periods of time, and some plots as the predictive distribution, and return level plots.

**mev:** Multivariate Extreme Value Distributions

**Author:** Leo Belzile, Jennifer L. Wadsworth, Paul J. Northrop, Scott D. Grimshaw, Jin. Zhang, Michael A. Stephens, Art B. Owen, Anthony C. Davison, Raphael Huser (2017).

**R package version:** 1.10

<https://cran.r-project.org/web/packages/mev/index.html>

**Description:** Exact simulation from max-stable processes and multivariate extreme value distributions for various parametric models. Threshold selection methods.

**mvPot:** Multivariate Peaks-over-Threshold Modelling for Spatial Extreme Events

**Author:** Raphael de Fondeville (2017).

**R package version:** 0.1.2

<https://cran.r-project.org/web/packages/mvPot/index.html>

**Description:** Tools for high-dimensional peaks-over-threshold inference and simulation of spatial extremal processes.

**NHPoisson:** Modelling and Validation of Non Homogeneous Poisson Processes

**Authors:** Ana C. Cebrian (2015)

**R package version:** 3.1

<https://cran.r-project.org/web/packages/NHPoisson/index.html>

**Description:** Statistical tolerance limits provide the limits between which we can expect to find a specified proportion of a sampled population with a given level of confidence. This package provides functions for estimating tolerance limits (intervals) for various univariate distributions (binomial, Cauchy, discrete Pareto, exponential, two-parameter exponential, extreme value, hypergeometric, Laplace, logistic, negative binomial, negative hypergeometric, normal, Pareto, Poisson-Lindley, Poisson, uniform, and Zipf-Mandelbrot), Bayesian normal tolerance limits, multivariate normal tolerance regions, nonparametric tolerance intervals, tolerance bands for regression settings (linear regression, nonlinear regression, nonparametric regression, and multivariate regression), and analysis of variance tolerance intervals. Visualizations are also available for most of these settings.

**PerformanceAnalytics:** Econometric tools for performance and risk analysis

**Author:** Brian G. Peterson, Peter Carl, Kris Boudt, Ross Bennett, Joshua Ulrich, Eric Zivot, Matthieu Lestel, Kyle Balkissoon, Diethelm Wuertz (2014).

**R package version:** 1.4.3541

<https://cran.r-project.org/web/packages/PerformanceAnalytics/index.html>

**Description:** Collection of econometric functions for performance and risk analysis. This package aims to aid practitioners and researchers in utilizing the latest research in analysis of non-normal

return streams. In general, it is most tested on return (rather than price) data on a regular scale, but most functions will work with irregular return data as well, and increasing numbers of functions will work with P&L or price data where possible.

**POT:** Generalized Pareto Distribution and Peaks Over Threshold

**Author:** Mathieu Ribatet, Christophe Dutang (2016)

**R package version:** 1.1-6

<https://cran.r-project.org/web/packages/POT/index.html>

**Description:** Some functions useful to perform a Peak Over Threshold analysis in univariate and bivariate cases.

**QRM:** Provides R-Language Code to Examine Quantitative Risk Management Concepts

**Authors:** Bernhard Pfaff, Marius Hofert, Alexander McNeil (S-Plus original (QRMLib)), Scott Ulmann (First R port as package QRMLib) (2016)

**R package version:** 0.4-13

<https://cran.r-project.org/web/packages/QRM/index.html>

**Description:** Accompanying package to the book Quantitative Risk Management: Concepts, Techniques and Tools by Alexander J. McNeil, Rüdiger Frey, and Paul Embrechts.

**Relns:** Functions from "Reinsurance: Actuarial and Statistical Aspects"

**Author:** Tom Reynkens, Roel Verbelen (R code for Mixed Erlang distribution), Anastasios Bardoutsos (Original R code for cEPD estimator), Dries Cornilly (Original R code for EVT estimators for truncated data), Yuri Goegebeur (Original S-Plus code for basic EVT estimators), Klaus Herrmann (Original R code for GPD estimator) (2017).

**R package version:** 1.0.2

<https://cran.r-project.org/web/packages/Relns/index.html>

**Description:** Functions from the book "Reinsurance: Actuarial and Statistical Aspects" (Wiley, 2017) by Hansjoerg Albrecher, Jan Beirlant and Jef Teugels.

**Renext:** Renewal Method for Extreme Values Extrapolation

**Author:** Yves Deville, IRSN (2016)

**R package version:** 0.3

<https://cran.r-project.org/web/packages/Renext/index.html>

**Description:** Peaks Over Threshold (POT) or 'methode du renouvellement'. The distribution for the exceedances can be chosen, and heterogeneous data (including historical data or block data) can be used in a Maximum-Likelihood framework.

**RTDE:** Robust Tail Dependence Estimation

**Authors:** Christophe Dutang, Armelle Guillou, Yuri Goegebeur (2015)

**R package version:** 0.2-0

<https://cran.r-project.org/web/packages/RTDE/index.html>

**Description:** Robust tail dependence estimation for bivariate models.



**SpatialExtremes:** Modelling Spatial Extremes

**Authors:** Mathieu Ribatet, Richard Singleton, R Core team (2015)

**R package version:** 2.0-2

<https://cran.r-project.org/web/packages/SpatialExtremes/index.html>

**Description:** Tools for the statistical modelling of spatial extremes using max-stable processes, copula or Bayesian hierarchical models.

**texmex:** Statistical Modelling of Extreme Values

**Authors:** Harry Southworth, Janet E. Heffernan, Paul D. Metcalfe (2013).

**R package version:** 2.3

<https://cran.r-project.org/web/packages/texmex/index.html>

**Description:** Statistical extreme value modelling of threshold excesses, maxima and multivariate extremes. Univariate models for threshold excesses and maxima are the Generalised Pareto, and Generalised Extreme Value model respectively. These models may be fitted by using maximum (optionally penalised-) likelihood, or Bayesian estimation, and both classes of models may be fitted with covariates in any/all model parameters.

**tolerance:** Statistical Tolerance Intervals and Regions

**Authors:** Derek S. Young (2017)

**R package version:** 1.3.0

<https://cran.r-project.org/web/packages/tolerance/index.html>

**Description:** Statistical tolerance limits provide the limits between which we can expect to find a specified proportion of a sampled population with a given level of confidence. This package provides functions for estimating tolerance limits (intervals) for various univariate distributions (binomial, Cauchy, discrete Pareto, exponential, two-parameter exponential, extreme value, hypergeometric, Laplace, logistic, negative binomial, negative hypergeometric, normal, Pareto, Poisson-Lindley, Poisson, uniform, and Zipf-Mandelbrot), Bayesian normal tolerance limits, multivariate normal tolerance regions, nonparametric tolerance intervals, tolerance bands for regression settings (linear regression, nonlinear regression, nonparametric regression, and multivariate regression), and analysis of variance tolerance intervals.

**VaRES:** Computes value at risk and expected shortfall for over 100 parametric distributions

**Authors:** Saralees Nadarajah, Stephen Chan and Emmanuel Afuecheta (2013)

**R package version:** 1

<https://cran.r-project.org/web/packages/VaRES/index.html>

**Description:** Computes Value at risk and expected shortfall, two most popular measures of financial risk, for over one hundred parametric distributions, including all commonly known distributions. Also computed are the corresponding probability density function and cumulative distribution function.

**VGAM:** Vector Generalized Linear and Additive Models

**Author:** Thomas W. Yee (2017)

**R package version:** 1.0-3

<https://cran.r-project.org/web/packages/VGAM/index.html>

**Description:** An implementation of about 6 major classes of statistical regression models.

## Python software package for Extreme Value Analysis

### **Extremes 1.1.1**

**Author:** Phillip J. Eby

<https://pypi.python.org/pypi/Extremes/1.1.1>

**Description:** Production-quality 'Min' and 'Max' objects.

### **Imoments 0.2.3**

**Author:** Sam Gillespie

<https://pypi.python.org/pypi/Imoments/>

**Description:** This library was designed to use L-moments to predict optimal parameters for a number of distributions. Distributions supported in this file includes; Generalised Extreme Value (GEV), Generalised Pareto (GPA), Gumbel (GUM), Weibull (WEI).

### **scikit-extremes**

<http://kikocorreoso.github.io/scikit-extremes/sources/index.txt>

**Description:** scikit-extremes is a python library to perform univariate extreme value calculations.

### **wafo 0.3.1**

**Author:** WAFO-group

<https://pypi.python.org/pypi/wafo/>

**Description:** Wave Analysis for Fatigue and Oceanography

## Matlab software package for Extreme Value Analysis

### **EVIM: A Software Package for Extreme Value Analysis in MATLAB**

**Current version:** 2006

**Authors:** Genay, Ramazan; Seluk, Faruk; Ulugulyagci, Abdurrahman (2001)

<http://www.swmath.org/software/255>

**Description:** A software package for extremel value analysis in MATLAB.

### **NEVA: Nonstationary Extreme Value Analysis**

**Software Package Version:** 2.0

**Author:** Linyin Cheng (2014)

<https://uk.mathworks.com/matlabcentral/fileexchange/48238-nonstationary-extreme-value-analysis--neva--toolbox?requestedDomain=www.mathworks.com>

**Description:** The Nonstationary Extreme Value Analysis (NEVA) software package has been developed to facilitate extreme value analysis under both stationary and nonstationary assumptions.

### **WAFO: Wave Analysis for Fatigue and Oceanography**

**Version:** 2.6-beta

**Authors:** MATLAB Central Team (2000)

<http://www.maths.lth.se/matstat/wafo/>

**Description:** WAFO is a toolbox of Matlab routines for statistical analysis and simulation of random waves and random loads.

## Other software package for Extreme Value Analysis

### GUI package: Xtremes 3.0

<http://archive.is/kgNns>

**Description:** A professional version of the package, which allows for large datasets to be analyzed, is available for purchase at Xtremes represents a fairly complete analysis package aimed primarily at finance and hydrology applications, but the methods are generally applicable.

### GUI software package written in C++: EXTREMES 2.0

<http://extremes.gforge.inria.fr/>

**Description:** The EXTREMES software gathers different tools dedicated to extreme values study. More precisely, it focuses on extreme quantiles estimation and model selection for distribution tails. It is written in C++ with a graphical user interface developed with the library QT. This solution matches rapid execution and user-friendliness.

### Commercial standalone software products: HYFRAN and HYFRAN-PLUS (HYdrological FREquency ANALYSIS)

**Authors:** Group of researchers at INRS University, Canada

<http://www.wrpllc.com/books/HyfranPlus/hyfranplusdescrip.html>

**Description:** is a software used to fit statistical distributions. It includes a number of powerful, flexible, user-friendly mathematical tools that can be used for the statistical analysis of extreme events. It can also, more generally, perform basic analysis of any time series of Independent and Identically Distributed (IID) data.

### S-Plus Software: S+FinMetrics 2.0

**Authors:** Andrew Bruce, Doug Martin, Jiahui Wang, Eric Zivot and developed by Insightful Corporation.

<https://faculty.washington.edu/ezivot/MFTS2ndEditionFinMetrics.htm>

**Description:** Provides advanced analytic-rich software for modeling, analyzing, and visualizing financial market data. The software offers the most comprehensive, modern, and flexible analytic tool available for precise, predictive econometric modeling of financial time series.

### Fortran: GLSNet

**Version:** 2.6

[https://water.usgs.gov/cgi-bin/man\\_wrdapp?glsnet\(1\)](https://water.usgs.gov/cgi-bin/man_wrdapp?glsnet(1))

**Description:** Performs prediction of low/high flows at non-instrumented locations using regression techniques and generalized least squares.

### Fortran: peakFQ

**Version:** 7.1

<https://water.usgs.gov/software/PeakFQ/>

**Description:** Estimates annual peak flows for several return periods by fitting a Pearson Type III distribution, i.e., a Gamma distribution, using the logarithmic sample moments.