Using a mixture of estimation methods for fitting the GEV distribution

Pierre Ailliot
Université de Brest, France

Craig Thomson
Wellington, New Zealand

Peter Thomson
Statistics Research Associates Ltd, New Zealand

Abstract

The generalised extreme-value (GEV) distribution is widely used for modelling and characterising extremes. It is a flexible 3-parameter distribution that combines three extreme-value distributions within a single framework: the Gumbel, Frechet and Weibull. Common methods used for estimating the GEV parameters are the method of maximum likelihood and the method of L-moments.

This paper generalises the mixed maximum likelihood and L-moments GEV estimation procedures proposed by Morrison and Smith (2002) and derives the asymptotic properties of the resulting estimators. Analytic expressions are given for the asymptotic covariance matrices in a number of important cases, including the estimators proposed by Morrison and Smith (2002). These expressions are verified by simulation and the efficiencies of the various estimators established.

The asymptotic results are compared to those obtained for small to medium-size samples by simulation with the estimated parameters and quantiles assessed for accuracy and bias. Using simplified constraints for the support of the log-likelihood, computational strategies and graphical tools are developed which lead to computationally efficient, numerically robust, estimation procedures suitable for automatic batch processing of many data sets. The methods are illustrated by application to annual maximum rainfall data at a large number of New Zealand locations. For Wellington, 24-hour annual maximum rainfall over the period 1940--1999 is also considered within each phase of the Interdecadal Pacific Oscillation.

Keywords: Extremes; GEV distribution; mixed estimation methods; asymptotic properties; small samples; quantile estimation; constrained maximum likelihood; rainfall.

References:

Ailliot, P., Thompson, C.S. and Thomson, P.J. (2011) Mixed methods for fitting the GEV distribution. *Water Resources Research* **47**, W05551, doi:10.1029/2010WR009417.

Morrison J.E. and Smith J.A. (2002) Stochastic modeling of flood peaks using the generalized extreme value distribution. *Water Resources Research* **38**, 1305, doi:10.1029/2001WR000502.