A COMPARISON OF FITTING METHODS AND TESTS FOR SEVERAL DISTRIBUTIONS ON COMPUTER GENERATED SAMPLES

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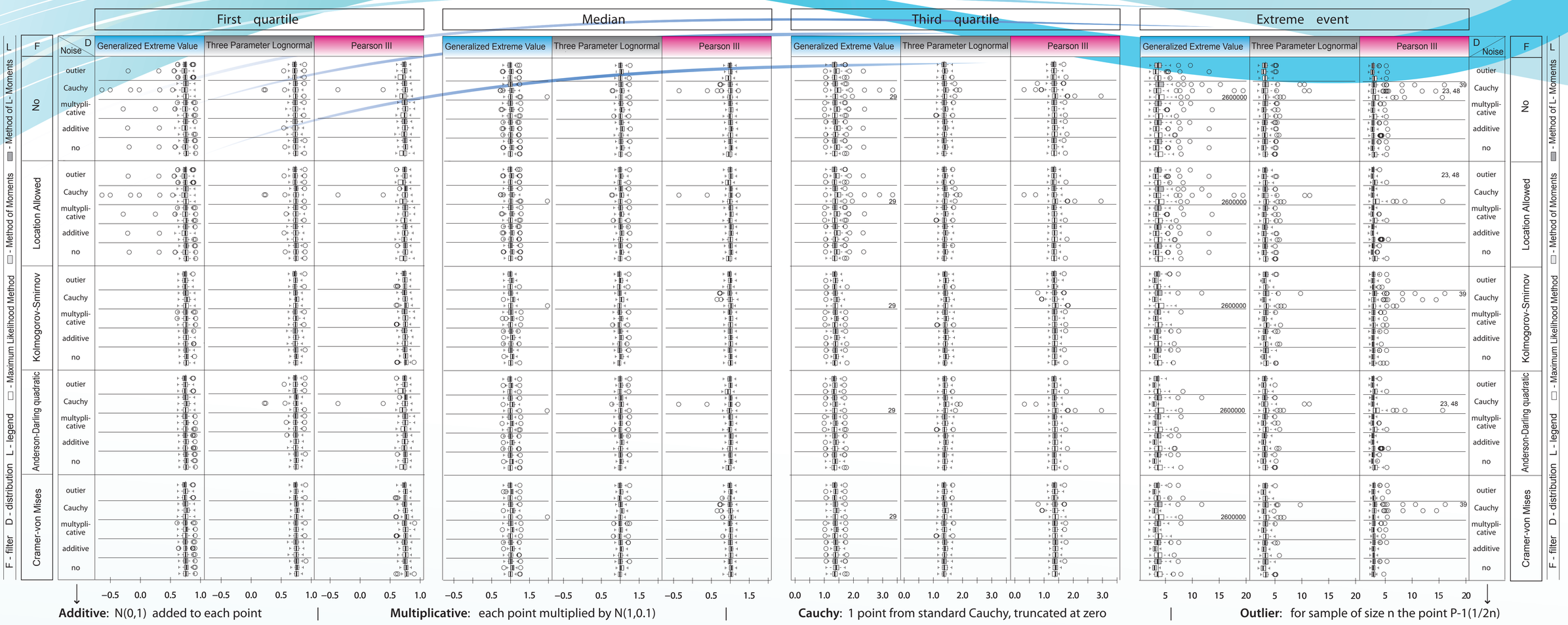
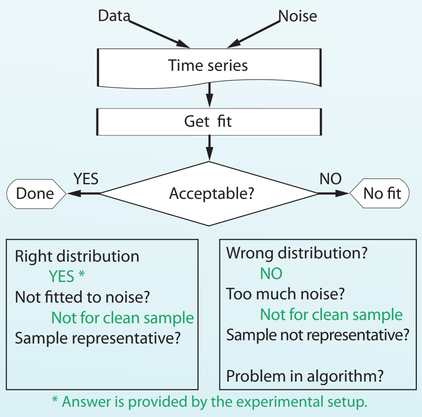


Introduction

In hydrology probability distributions are fitted to data in different contexts and with different techniques. The context may be the study of annual maxima or rainfall intensity-duration-frequency curves or even synthetic unit hydrographs. There are many different ways to evaluate the usefulness of the resulting fit. We conduct a series of Monte Carlo experiments to study the interaction between fitting method, evaluation method and purpose. We use samples both without and with noise.



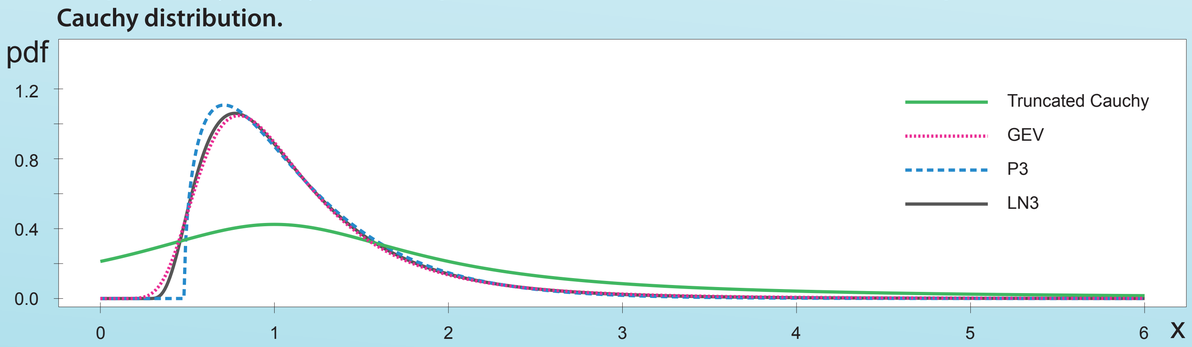
* Answer is provided by the experimental setup.

When a distribution is fitted to hydrological data there are questions that remain unanswered even after the results of a fitting method and one or more tests are known.

Fitting Method, Distribution and Purpose

In the preliminary experimental results presented here there were hints that in some cases one fitting method may do better than another for a particular purpose. Example: for P3 a study of details of the results suggested that in terms of bias and inter-quartile distance L-moments did better for the extreme value, while the method of moments did better overall for the first, second and third quartile.

The probability density function (pdf) of GEV, P3 and LN3. Also shown is the pdf for the truncated Cauchy distribution.



The Distributions

Generalized Extreme Value	GEV
Pearson III	P3
Three parameter lognormal	LN3

All with first quartile at 0.75, median at 1 and third quartile at 1.375.

Visualization of Results

The Tukey plots show first, second and third quartile as a box and whiskers to the leftmost and rightmost data points within a range of 1.5 times the inter quartile distance. Points outside that range are shown as circles or, when they lie too far outside the range, with annotations in the plots.

Can a Test Detect Problematical Fits?

From the results it seems clear that some form of testing is beneficial. A logical next step would be to see if variations on the chi squared test with classes aimed at a particular purpose might do better. This still leaves open the question of what to do if there is no good fit to be found. If we try distributions until one gives a good fit then we run the risk of perfectly fitting a sample that is not at all representative of the population from which it was taken.

Correspondence Between Data and Distribution

For the quartiles none of the distributions provides a clearly better fit, but without a test LN3 has a larger spread due to one or more points far from the median. For the extreme value P3 seems to do slightly better than the others with respect to bias, except for one sample where it puts the extreme value at 6300.

Fitting Method and Suitability of the Resulting Fit (Extreme Value)

The method of moments did well for GEV, LN3 and P3 without a test, but seemed to underestimate the value when combined with a test. For GEV with a test Maximum Likelihood (ML) had a smaller bias than L-moments. For LN3 with a test ML and L-moments did equally well, perhaps with a slight advantage for ML. For P3 both ML and L-moments did well, but ML seemed to do slightly better.

Fitting Method and Suitability of the Resulting Fit (Quartiles)

For the quartiles there seems to be no clear winner for GEV, although perhaps ML has slightly less bias for the third quartile than L-moments, which in turn does slightly better than the method of moments. For LN3 it is hard to point to a clear favorite for the three quartiles together. The same holds for P3.

Can Goodness of Fit Tests Improve the Suitability of a Fit for a Particular Purpose?

Kolmogorov-Smirnov (KS), Cramér-von Mises (W2) and Anderson-Darling (AD2) all remove some of the extreme values for the quartiles. For the extreme value the effect is most pronounced for GEV. The AD2 test is best as a filter when looking at the extreme value for P3.

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