



## Maximum Likelihood and Interval Arithmetic

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In hydrology and water management many different distributions are in use. They are used to generate rain-fall events, to study the probability of extreme and non-extreme events with regards to discharge, water level or precipitation and serve as marginal distributions when studying events with multiple characteristics for example maximum discharge, total volume, and duration for floods. Maximum Likelihood Estimation (MLE) is one of the parameter estimation techniques in use. Its charm is its wide applicability and standardized approach. While the resulting optimization problem is fairly straightforward for some distributions, it can be quite complex for others. We show that for the Generalized Gamma Distribution, where the Maximum Likelihood function is known to cause problems for optimizers, the application of global optimization based on interval arithmetic can generate a mathematically correct overview of the location of all local extremes of the Maximum Likelihood function. We also test the method on several other distributions currently in use in hydrology. The aim is to add a very robust optimization method to MLE and so create a tool that is easy to apply.

**Keywords:** maximum likelihood; interval arithmetic; generalized Gamma distribution.