Bayesian approach to extreme quantile estimation through threshold methods

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Abstract

Parametric and semi-parametric methodologies have been widely used in extreme quantile estimation. Among the parametric methodologies it is recognised the importance of the Peaks Over Threshold (POT) method, which consists on fitting a stochastic model to the excesses (or exceedances) above a very high threshold. However two relevant issues should be referred about both parametric and semi-parametric methodologies. On one side they focus on the estimation of the parameters of the models, making secondary the extreme quantile estimation. In fact the extreme quantiles are obtained as functions of the estimated model parameters, not considering their sampling variation. On the other side the success of these methodologies highly depends on the choice of the number of upper order statistics to be selected. The results which have been obtained so far in order to select the number of upper order statistics are scarce and some of these results are very theoretical, therefore difficult to be used in practical applications.

This study aims to approach the estimation of extreme quantiles through the POT method from a Bayesian point of view. In this framework the number of upper order statistics to be used in the analysis and the other parameters of the models are considered random, with appropriate prior distributions. The estimation of the extreme quantiles is then carried out through the predictive distribution, which produces the forecasted quantiles as a weighted average of all possible values of the parameters, the weights being the posterior distributions.

Estimated extreme quantiles will be presented for various distributions which belong to the domain of attraction of the Gumbel distribution, by using simulated data. The method which is developed will then be compared with other methods currently used for extreme quantile estimation. Finally the model will be tested using real data. In the future these results will be generalised to other domains of attraction.

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