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Exploring the best procedure for estimating extreme quantiles: a case study

P. A. D. A. N. Appuhamy[1*] and T. D. A. G. Thewarapperuma[1]

[1]Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka
asankanidarshani@wyb.ac.lk*

The investigation of extreme events within the insurance sector holds significant importance as it aids in evaluating the potential risk associated with such occurrences in the future. These events, including natural disasters, fires, and other unforeseen incidents, often lead to substantial insurance claims. The conventional Peak-Over-Threshold (POT) approach offers a solid theoretical basis for examining extreme claims risk. Nevertheless, this method is hindered by limited tail data. To address this limitation, the folding procedure, an improved POT approach, was introduced by the researchers as an alternative which effectively generates a larger tail sample. The objectives of the study were to compare and select the best procedure for estimating the extreme quantiles of the fire claims distribution. The study utilized daily fire claim data collected throughout the year 2021 from a leading insurance company in Sri Lanka. In the conventional POT approach, the excess values over a high threshold are modelled as a Generalized Pareto distribution (GPD). Unlike the conventional approach, the folding procedure involves folding data points below the threshold to values above it, prior to modelling the excesses as the GPD. The rule of thumb method was used to determine the threshold for both procedures. Additionally, to address the issue of limited tail data, the conventional POT approach was employed with various parameter estimation methods, including Maximum Likelihood Estimation (MLE), Probability Weighted Moment Unbiased (PWMU), and Biased (PWMB) methods, to estimate the parameters of the GPD, which are available in R software. However, for the folding approach, only the Maximum Likelihood Estimation (MLE) method was utilized, as it has been found to accurate, when a large sample is available for estimation. Finally, the accuracies of extreme quantile estimates obtained from the GPDs fitted through both procedures were compared using the Mean Squared Error (MSE) values. The method with the minimum MSE was selected as the best. The study unveiled a heavy-tailed distribution of fire insurance claims during the study period, exhibiting skewness and kurtosis values of 8.89 and 91.7 respectively. Furthermore, the folding procedure yielded a smaller MSE value (1.14), in contrast to the MLE based conventional POT method (1.26). However, the conventional POT approach with PWMB and PWMU exhibited more accurate estimation (MSE=0.30 and 0.38, respectively) than the folding procedure with MLE. In conclusion, the conventional POT method with PWMB was found to be the superior procedure for estimating extreme quantiles of the fire claims distribution, as compared to the folding procedure with MLE. This information would assist in implementing effective risk management strategies to mitigate financial impacts stemming from future extreme claims.

Keywords: Claim, Extreme value, Insurance, Risk