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Modelling extreme motor insurance claims with extreme value theory: A case study from Sri Lanka

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In recent years, the motor insurance business has grown significantly in Sri Lanka due to the excessive importation of vehicles. However, the large volumes of vehicles on the road increase the risk of occurrence of extreme claims, which undermine the profit and sustainability of the business. In response to this, researchers attempted to model the extreme claims as accurate information on the tail is critical to determine the appropriate level of insurance premium, reserves and re-insurance, which assures a profitable business. The objective of this study is to identify the best fit model for extreme motor insurance claims. The motor claims obtained from one of the pioneer insurance companies in Sri Lanka from July to December 2021 were considered for this study. The Peak Over Threshold (POT) approach of the Extreme Value Theory was utilized for modelling, which approximates the excess claim amounts over a sufficiently high threshold as the Generalized Pareto Distribution (GPD). The claim amounts at 20 percentiles between 79% and 98%, which covers the range of values proposed in the literature for sufficiently high thresholds, were considered as tentative thresholds to find the optimal that separates extremes from bulk. Then the excess amounts over each of these tentative thresholds were modelled separately as GPD using four different parameter estimation methods, viz. Maximum Likelihood Estimation (MLE), Method of Moment (MOM), Unbiased Probability Weighted Moment (UPWM) and Biased Probability Weighted Moment (BPWM) to identify the best in case of the dearth of information for the tail. Next, the accuracies of the fitted GPDs at each tentative threshold for each parameter estimation method were evaluated by calculating the Mean Squared Errors (MSEs). Then MSEs were compared to select the optimal threshold and the best parameter estimation method, which yielded the best fit model for tail data. The threshold and the parameter estimation method with minimum MSE were selected as the optimal threshold and the best parameter estimation method, respectively and the GPD fitted under these conditions was selected as the best. The validity of modelling as the GPD was tested using the bootstrap goodness of fit. It was revealed that the amount of motor claims varied from Rs. 2,167.00 to 193,065.00 during the study period. Moreover, the motor claims were positively skewed with a skewness of 2.45 and leptokurtic, which confirms heavy-tailed. The minimum MSE was attained at the threshold of 91% (Rs. 61,056.00) with the BPWM method. There were 47 claims above 91% identified as extremes which can be best described by GPD with shape and scale parameters of 1.02 and 92.09, respectively. The p-value (0.997>0.05) of the bootstrap test confirms the GPD with a positive shape parameter for extreme motor claims. Findings confirm the existing results in the literature that PWM methods are preferred when the shape parameter is positive and less than or equal to 1 and the sample size for modelling is small. The information on tail helps to review existing strategies for better management of risk due to such extreme claims in future.

Keywords: Claims, Insurance, Percentile, Threshold