Robust Statistics vs. MLE for OpRisk Severity Distribution Parameter Estimation (with and without truncation)

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ABSTRACT:

In operational risk measurement, severity distribution parameter estimation is the main driver of the aggregate loss distribution, yet it remains a non-trivial challenge for many reasons. Maximum likelihood estimation (MLE) does not adequately meet this challenge because of its well-documented non-robustness to modest violations of idealized textbook model assumptions (e.g. independent and identically distributed (i.i.d.) data, which OpRisk loss event data clearly violate). Even under i.i.d. data, the expected value of capital estimates based on MLE is biased upwards due to Jensen's inequality. This overstatement of the true risk profile increases as the heaviness of the severity distribution tail increases, so dealing with data collection thresholds by using truncated distributions, which have thicker tails, increases MLE's bias considerably. In addition, truncation typically induces dependence between a distribution's parameters (if not there already), and this exacerbates the non-robustness of MLE. This paper derives influence functions for MLE under a number of severity distributions, truncated and not, to analytically demonstrate its non-robustness. Simulations and empirical influence functions are then used to empirically compare its statistical properties (robustness, efficiency, and unbiasedness) to those of robust alternatives such as OBRE and a common minimum distance estimator (CvM). SLA (single-loss approximation) translates these parameter estimates into (VaR) estimates of regulatory capital requirements. These results show that OBRE estimators are very promising alternatives to MLE for use with actual OpRisk loss event data, whether truncated or not, when the ultimate goal is to obtain accurate (non-biased) capital estimates.

Keywords:

- OBRE
- Basel II
- MLE
- Severity Distribution
- Robust Statistics
- Capital Quantification
- Economic Capital