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Estimating the required surplus, benchmark profit, and optimal reinsurance retention for an insurance enterprise using the compound Poisson distribution

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This paper presents an analysis of the capital needs, needed return on capital, and optimal reinsurance retention for insurance companies, all within the context of the compound Poisson distribution. As an alternative to much of the present practice, it focuses on closed form expressions and closed form approximations, rather than ocusing on how to estimate such values using Monte Carlo simulation. The analysis is also done using a distribution-free approach with respect to the loss severity distribution. It shows how the risk of extreme aggregate losses that is inherent in insurance operations may be understood (and, implicitly, managed) by using key values from the loss severity distribution. The capital and surplus needs of a company are then estimated using a VaR approach. A tractable formula for the benchmark pro t need of a company is developed. An analysis of the economically optimal reinsurance retention/policy limit is performed as well. It shows that that the marginal (across loss caps) profit need should equal to the marginal reinsurer loading on losses. Analytical expressions are then developed for the optimal reinsurance retention. Approximations to the optimal retention based on the normal distribution are developed and their error is analyzed in great detail. For sample data that is known to be difficult to approximate with a normal distribution, the results indicate the normal approximation to the optimal retention is acceptable. The impacts of those results on other aspects of insurance company operations are discussed. It discusses that there is a logical limit on insurance benefits beyond which the cost of the insurance outweighs the benefits. Also, the benchmark loading for profit and the amount needed to recompense investors for diversifiable risk is discussed. An analysis of whether or not the loading for diversifiable risk is needed is performed, suggesting that some small load for the randomness of insurance claims is required to support the capital employed by an insurance company. The profit load needed in the rates is shown to be independent of how an insurance company invests its assets, and as such is mostly independent of the CAPM “beta” of the company as a whole. It is shown to be related strictly to the risk-free rate and the asset structure of an insurance company in the most common cases.