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Claims reserving in the presence of excess-of-loss reinsurance using micro models based on aggregate data

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ABSTRACT

This paper addresses a new problem in the literature, which is how to consider reserving issues for a portfolio of general insurance policies when there is excess-of-loss reinsurance. This is very important for pricing considerations and for decision making regarding capital issues. The paper sets out how this is currently often tackled in practice and provides an alternative approach using recent developments in stochastic claims reserving. These alternative approaches are illustrated and compared in an example using real data. The stochastic modelling framework used in this paper is Double Chain Ladder, but other approaches would also be possible. The paper sets out an approach which could be explored further and built on in future research.

1. Introduction

The subject of this paper is the distribution of outstanding claims for a portfolio of general insurance policies in the presence of excess-of-loss reinsurance protection. This is a subject area which, to the best knowledge of the authors, has not previously appeared in the actuarial literature. It is a very important subject from a practical point of view, and there have been many papers on the estimation of outstanding claims and reinsurance separately to develop both the theory and practical tools for actuaries. To date, they have not been considered together.

This is perhaps surprising because the estimation of outstanding claims net of reinsurance for such a portfolio is very commonly needed, for example when a reinsurance underwriter is pricing either a retrospective loss portfolio transfer treaty or a prospective proportional quota share on the retention. These are both actively used for solvency capital management and it would therefore be desirable to have estimates of both the expected net outstanding claims and the uncertainty around these. Better still would be estimates of the distribution of net outstanding claims. This paper develops methods to address all of these issues for excess-of-loss reinsurance and compares the results with what is often done in the practical context using existing reserving methods.

With the advances in stochastic reserving methodology, it is now possible to develop coherent theoretical frameworks for the estimation of the distribution of outstanding claims net of excess-of-loss reinsurance. It is important to note that the most commonly used stochastic claims reserving methods, such as bootstrapping the over-dispersed Poisson model (England and Verrall, 1999, 2002), will be of limited value in this context. The fundamental issue that needs to be addressed is how to consider the net outstanding claims such that the effect of the excess-of-loss reinsurance contract can be accurately taken into account. The only way to do this is to use a model which considers individual claims, or at least one which simulates future claims individually rather than aggregated.

Individual claims reserving, or reserving based on granular data, has been the subject of increased attention in actuarial literature. See for example Antonio and Plat (2014). The majority of the methods which have been developed operate entirely at the level of individual claims and this can perhaps make them appear to be overly complex to implement and use in a practical context. In contrast, a series of papers beginning with Verrall et al. (2010) and continuing with Martínez-Miranda et al. (2011), Martínez-Miranda et al. (2012), Martínez-Miranda et al. (2013b) and Martínez Miranda et al. (2015) has developed a hybrid approach which uses data aggregated in the standard way into triangles in order to estimate models for claims at the individual level. We believe that this makes it easier to apply the fundamental advantages of stochastic reserving for individual claims using the theory which has recently been developed to more complex practical issues such as excess-of-loss reinsurance. Of course, it would be possible to investigate these practical issues using other individual claims reserving methods, and we anticipate that this may be done in the future by other authors.

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In this paper, we bring together all the methodology developed in the papers above based around the Double Chain Ladder (DCL) method. It is clear that in the practical context it is important to have stable estimates of all parameters if practically useful simulations of future claims are to be generated. This means that it is important to use the full range of methods available within the framework of DCL, paying particular attention to the way claims increase with accident period.

The paper is set out as follows. Section 2 outlines the approach which is commonly used in practice when considering reserves with reinsurance. Section 3 summarises the theoretical model which we will use in this paper, DCL. Section 4 revisits the Bayesian DCL method of Martínez-Miranda et al. (2013b) and the basic assumptions of a Bornhuetter–Ferguson approach giving a modification to DCL of Martínez-Miranda et al. (2012), which we call Bornhuetter–Ferguson Double Chain Ladder prior (BDCL prior). In Section 5 we describe how the data are usually prepared in practice in order to analyse the claims net of reinsurance (and the reinsurers claims). In Section 6 we show how this can be done in a more coherent way within the framework of DCL and BDCL prior. Sections 5 and 6 also contain illustrations and comparison of the practical approach and the new approach. Section 7 contains the conclusions.

2. The practical approach

In general insurance or casualty portfolios (including general third party liability, motor third party liability, employer's liability, medical malpractice) insurance companies commonly seek excess-of-loss reinsurance protection on an occurrence year basis. This means that the insurer's exposure to any individual loss occurring in any given year is limited to a predefined amount called the retention or priority. The retention is usually chosen taking into account the volatility of claims which are likely to arise from the portfolio, the insurer's risk appetite and solvency position. And in practice it is also driven by past experience of claims from the portfolio and the available price in the market. Typically, these reinsurance treaties have a one year duration and are renegotiated every year so that the retention level may change from year to year. There may be clauses in the treaties which affect the actual retention on claims each year: for example, an indexation clause. Thus, whenever data are considered over a period of years for such portfolios, the insurer's retained amounts for any individual loss will be dependent on the year in which the loss occurred.

The estimation of the ultimate net incurred claims in order to set the net total unpaid reserve for such a portfolio is a common actuarial task for reinsurance underwriters when asked to price either a retrospective loss portfolio transfer (LPT) treaty or a prospective proportional quota share (QS) on the retention. In the case of a LPT, the cession to the LPT reinsurer can be either on a gross basis, in which case the cedent will transfer the right of recoveries from excess-of-loss reinsurers to the LPT reinsurer, or a net basis, which means that only the retained loss portfolio is ceded. However, irrespective of the cession basis (assuming an acceptable counterparty rating of the excess-of-loss reinsurers) the evaluation of the reserves is to be done on the loss portfolio net of historical inuring excess-of-loss recoveries. In the case of the prospective QS, the actual historical excess-of-loss retentions are ignored as the estimation of the net outstanding claims is carried out on an 'as-if' basis using a common historical retention equal to that of a prospective excess-of-loss treaty. From a theoretical point of view, QS is a simpler subcase of what would be the more generalised case of the LPT where instead of one common excess-of-loss retention for all years there can be different historical retentions depending on the conditions of each year's excess-of-loss treaty. In this paper, we will consider the QS case, thereby assuming one common retention for all occurrence years.

Typically, the kind of data the reinsurer receives for the purpose of pricing these treaties may come in various formats. If the systems of the insurer are set to account for the existence of excess-of-loss reinsurance, it is possible to receive triangular data with incurred losses already capped at the historical retention. In short, these are known as net triangles. In addition to this, most insurers should be able to query their databases to produce net triangles at a given common retention. In practice, however, the insurance company will either supply gross triangles plus the recoveries triangles, or in the case of QS, gross triangles plus the triangulations of large individual claims, for example with incurred amount at 50% of the prospective retention or above. This is the typical threshold that an excess-of-loss reinsurer sets for the claims data requirement. If sufficient data about individual claims are available (particularly large claims), the QS reinsurer will be able construct the recoveries triangles and price the treaty at different levels of prospective excess-of-loss retention.

In practice, the reinsurance underwriter or actuary will estimate the net outstanding claims (in the case of an LPT) or the ultimate claims (in the case of QS) for each accident year by applying traditional actuarial reserving methods on the net triangles which result from subtracting the reinsurance recovery triangle from the gross triangle.

The problem with this approach is that although actuarial reserving methods can be applied to the resulting net triangle in the same way as they are applied to gross triangles, reinsurance recoveries for potential future development of individual claims or newly reported claims are not taken into account because the recoveries triangle construction is limited to the development period already observed. In other words, the recoveries triangle is constructed on the basis of the incurred value at the given valuation date and not on the basis of the ultimate cost of each claim. This presents many issues for the reinsurer to consider. Not only is the ultimate incurred value of a claim unknown, just the incurred value at the particular development point in time, but also the observation period for each of these claims depends on when they were reported. This typically results in there being no recoveries observed in recent accident years. In addition to this, different accident years may have different reporting lags. Ultimately this is a problem of incorrect sampling of the recoveries triangle and this leads to problems with the net triangle to which actuarial reserving methods are applied. As a result of this, it is not clear whether estimating the net reserve using the net triangles constructed in this way leads to reasonable point estimates.

As reinsurance is a very competitive business, price is the principal factor for an insurer in deciding whether to cede the portfolio to one particular reinsurer or another. In the case of capital motivated reinsurance transactions, reinsurance competes with other forms of capital such as subordinated debt, and the pricing implications of the estimation of net outstanding claims can also lead to a decision not to cede at all if the cost of reinsurance is directly compared to the cost of the capital relief such a transaction achieves. For these reasons, having more information about the accuracy of the estimation would be very desirable.

The ideal solution to this problem would be to estimate the ultimate incurred for each individual claim. This could be done by modelling the individual aspects of each claim, which could include (for example) loss of income, dependants, future inflation, medical expenses etc. This is the aim of claims adjusters, and it has to be recognised that their estimates can be quite volatile. An actuarial approach would be to simulate from the individual claims so that to estimate the ultimate recoveries per accident year. While there have been considerable advances in the consideration of individual claims data in recent years, the application of the methods would probably still present challenges in practical settings. For this reason, the approach in this paper is to use methods which