

# Picking the winners

**For a reinsurer with a large portfolio of contracts, how might it be able to improve its book by altering its participations in those contracts to offer the best expected profit given its risk appetite and capital resources? EMB has developed an optimisation method to help tackle this problem.**

## **Background**

When the senior pricing actuary of a significant reinsurer of property catastrophe risks approached EMB to see if we could help him improve selection of the type and share of contracts that would maximise profit going forward, it proved an irresistible challenge to EMB's modelling experts.

The solution involved a significant amount of research and, ultimately, influenced a development of the optimisation algorithms and calculation methodology that are offered within EMB's market-leading modelling platform, EMB Igloo™.

The early results have been nothing less than stunning, with our client estimating an incremental profit increase in the region of 33% across almost 1000 contracts.

## **Art and science**

Creating a balanced, diversified and profitable portfolio by adjusting the participation on risks according to how attractive the risk is, and the importance to the business of particular reinsurance brokers, is an art that is as old as reinsurance itself.

Technology has offered an extra dimension to the process. While it is not a replacement for underwriting judgement, stochastic modelling techniques in particular have opened the way to assess risk more quantitatively and to enhance the understanding of dependencies between risks.

Such methods have been very effective in helping reinsurers to price contracts and to assess capital requirements. Turning those techniques into a truly effective method for optimising reinsurance portfolios has previously proved difficult due to the inability of established mathematical optimisation algorithms to cope with the multiple parameters and constraints involved in portfolio selection. Model run times have also been a barrier to the viability of the approach.

## **Working the problem**

After investigating a number of options for calculating the optimal portfolio, the project team based the solution on the well-established Broyden-Fletcher-Goldfarb-Shanno method.

This method alone, however, is not enough to stop the next step calculations required for the optimisation process from potentially violating any of the portfolio constraints (such as total capital commitment, minimum or maximum percentage shares, capital boundaries by risk type and location, and contract groupings). Therefore, a secondary method is needed to track the constraints and eliminate certain scenarios from the calculation where the result would exceed the constraints.

One of the main obstacles was reducing the optimisation run times when the number of contracts increased. This was resolved with a subtle but crucial modification to the algorithm.

Not only does this produce a step change in the quality of the optimisation model but it massively improves model run times. Model runs that had lasted more than overnight at the start of the development process were cut to around 10 minutes by the time the initial project was delivered.



### Extending the reach

The majority of reinsurance optimisation exercises that EMB has been involved with to date have been focused on property catastrophe. But there is no reason why similar techniques can't be applied to any reinsurance portfolio or any other portfolio of risks written in a subscription market.

The scalability of the solution has also been demonstrated by our initial client. It has progressed from an initial trial of around 50 contracts to the point where it is now optimising its position on up to 1000 contracts.

A key part of the analysis is comparing the original participations with those in the optimal portfolio, and checking that the results are sensible. There can be some non-intuitive changes in both directions but this is an advantage of numerical optimisation: apart from making you check the model, it also makes you consider alternatives that may not have been obvious. A little bit of scenario testing will quickly confirm whether it is possible to beat the computer, within the capital and risk constraints.

### Summary

As far as we are aware, this methodology for optimising the mix of a reinsurer's portfolio in a stochastic modelling environment is unique within the insurance industry.

It has two major benefits:

- Compared to previous techniques, it increases the sophistication of analysis so that profit is truly maximised within the risk appetite and capital constraints
- It significantly reduces model run times

While it can never replace market knowledge and underwriting experience, all the results so far point to the added value it can bring to a problem that subscription reinsurers have grappled with since the birth of the industry.

### Dr Peter England - Director

Peter joined EMB in November 1999 after working as Manager, Capital Modelling at the Market Risk Unit at Lloyd's, where he was jointly responsible for the Risk Based Capital system used at Lloyd's. He is a Chartered Statistician with a PhD in Actuarial Science, and has over 20 years' experience in statistical and financial modelling. He is also a Senior Visiting Fellow at the Cass Business School, London, and is co-author of the prize-winning Institute of Actuaries paper "Stochastic Claims Reserving in General Insurance".

For further information, please contact [peter.England@emb.com](mailto:peter.England@emb.com)

