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SYNOPSIS

Title: Valuation of Large Variable Annuity Portfolios: Monte Carlo Simulation and Benchmark Datasets

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Key words: Variable annuity, Portfolio valuation, Monte Carlo, Metamodeling

Purpose of your paper: The purpose of this paper is to create some benchmark datasets that can be used by academic researchers to study the computational problems associated with the valuation of large portfolios of variable annuity contracts.

Synopsis: Variable annuities are life insurance policies that contain complex guarantees. Due to the complexity of the guarantees, there is no closed-form formula to calculate the value of the guarantees except for some special cases. Insurance companies rely heavily on the Monte Carlo simulation method to price the guarantees. However, it is very time-consuming to use the Monte Carlo simulation method to price a large portfolio that contains hundreds of thousands of variable annuity policies. For example, if we use a Monte Carlo simulation model with 1,000 risk-neutral scenarios and 360 monthly time steps to value a portfolio of 100,000 variable annuity policies, then the number of cash flow projections is 3.6×10^{10}. It will take a computer that can process 200,000 cash flow projections per second about 50 hours to finish the computation. As a result, valuation and risk management of such large portfolios are a big challenge to insurance companies.

Metamodeling has been proposed to address the computational challenge mentioned above. The metamodeling approach consists of two components: an experimental design method and a metamodel. The experimental design method is used to select a small number of variable annuity policies from a large portfolio. The metamodel is used to approximate the fair market value (or other quantities of interesting) of the portfolio based on the selected policies and their fair market values calculated by the Monte Carlo simulation model. However, it is extremely difficult, if not impossible, for researchers to obtain real datasets from insurance companies in order to test their metamodeling techniques on such real datasets and publish the results in academic journals. Even if a researcher can obtain real datasets from insurance companies, it is difficult for the researcher to share the datasets with the public at large. To facilitate the development and dissemination of research related to the efficient valuation of large variable annuity portfolios, this paper creates a large portfolio of variable annuity contracts based on the properties of real portfolios of variable annuities, implements a Monte Carlo simulation engine, and develops several benchmark datasets of fair market values and Greeks. The resulting datasets provide researchers with a common basis for testing and comparing the performance of various metamodeling techniques.

Note: If you are not presenting a paper for this Colloquium, please include as much detail as possible in your Synopsis (maximum three pages) to enable delegates to prepare for your session.

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