Project (3): Computation of Risk Measures for Guaranteed Minimum Withdrawal Benefit

*Project description:* The GMWB is among the most popular investment guarantees in the variable annuity industry. We intend to develop a deterministic algorithm to compute its risk-based capital requirement based on numerical partial differential equation (PDE) methods.

*Faculty leader:* Runhuan Feng

*Student participants (5):* Yao Haoqi, Lingqiao Zhang, Yang Xu, Zhan Zhang, Yufei Hou

*Progress report:*

- The students are currently meeting with Runhuan Feng on a weekly basis to learn numerical PDE methods.
- Runhuan Feng and coauthor Jan Vecer, from Frankfurt School of Finance and Management, Germany, are currently writing the research paper, the technical part of which has been completed.
- For training purposes, the students have been provided with a set of PDEs, for which analytical solutions are known. Each week they compete with each other to be the first to develop numerical algorithms. At the weekly meeting, we run numerical tests of their submitted codes against exact values from analytical solutions. The competition is based on both accuracy and time consumption.
- One student, Yufei Hou, has reached the stage of producing algorithms for the actual problem of computing risk measures for GMWB.
- In the pilot examples, the results of the algorithms appear to match those from simulations. More refinements are necessary to improve their accuracy.
- Runhuan Feng developed a set of exercises to illustrate how to solve PDEs using a variety of analytical and numerical methods. The exercises are largely based on stochastic processes of particular interest to actuarial and financial applications. These are posted on the website for anyone with an actuarial background who intends to learn computational techniques based on PDEs.
- Students have produces sample solutions to each challenge in the set of exercises (posted on the website).

*Status:* Completed. The research paper incorporating this research is completed and posted on the Undergraduate Research Program website.