English Name：The Risk Management Research for Variable Annuity based on Stochastic Models

Abstract

Variable annuity is a special insurance product. Insurance companies follow policy-holders' choice to invest in the capital market and pay policy-holders corresponding floating income according to the return on investment. Unlike ordinary insurance, variable annuities are more sensitive to the economic environment, policy changes, and social events because they are linked to the capital market. Therefore, the insured person bears higher risks. In this regard, the variable annuity gives policyholders the right to get a minimum guaranteed benefit: when the investment account value is lower than a fixed amount set at the time of signing, policyholders will receive a minimum benefit. This allows variable annuity holders to be protected when the market performance is poor and the return on investment is low. But at the same time, minimum benefit guarantee is a very important risk factor for insurance companies, so from the perspective of insurance companies, it is particularly important to carry out risk management for variable annuities. However, there are few risk management studies on variable annuities with minimum benefit guarantee. Therefore, we choose the Guaranteed Minimum Accumulation Benefit as an example to theoretically study two common risk management methods used by insurance companies: actuarial method and dynamic hedging method, and try to compare the advantages and disadvantages of them, providing some reference for insurance companies. Considering that variable annuity is closely related to stock investment and update margin amount at the end of each period, we apply geometric Brownian motion and Nested Stochastics in stochastic theory, hoping to give a quantitative framework for studying variable annuity risk management.

Key words: Variable Annuity; Guaranteed Minimum Maturity Benefit; Dynamic Hedging; Actuarial Risk Management; Stochastic Process

中文题目：基于随机模型的可变年金风险管理研究

摘　要

可变年金是一种特殊的保险产品，保险公司遵照投保人的选择在资本市场中进行投资，并依据投资回报给付投保人相应的浮动收益。区别于普通的保险，可变年金由于与资本市场挂钩，其受到经济环境、政策变动、社会事件的影响更为敏感，因此投保人承担的风险较高。对此，可变年金给予保单持有人获得最低保证利益的权利：当投资账户价值低于保单签订时设定的某个数额时，投保人可以收到最低利益保证金。这使得可变年金持有人在市场表现较差、投资收益很低的时候，能够获得保障。但同时，最低利益保证对保险公司来说是一个很重要的风险因素，这样从保险公司角度来说，对可变年金进行风险管理显得尤为重要。然而，目前学界对附带最低利益保证的可变年金很少有风险管理研究。因此，我们选择最低累积利益保证为例，从理论上研究目前保险公司常用的两种风险管理方法：预留风险的精算方法和动态对冲方法，试图比较出两者的优缺点，为保险公司提供一些参考。考虑到可变年金与股票投资密切相关，又有在每期末更新保证金的特性，我们应用了随机理论中的几何布朗运动、嵌套随机过程等知识，希望能给出研究可变年金风险管理的量化框架。

关键词：可变年金；最低利益保证；动态对冲；精算风险管理；随机过程