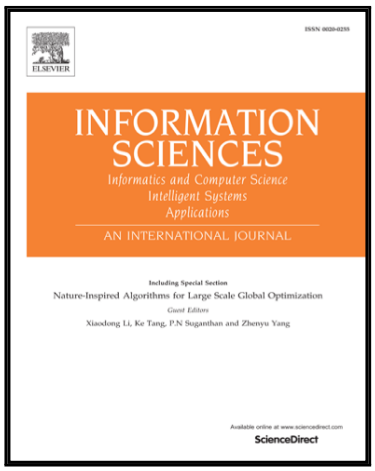

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Pricing of minimum guarantees in life insurance contracts with fuzzy volatility

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Abstract

We propose a model for the pricing of the minimum guarantee option embedded in equity-linked life insurance policies under uncertainty of randomness and fuzziness. The future lifetime of the insured is modelled as a random variable and the asset price evolution is described using a fuzzy binomial-tree model. In order to deal with both randomness and fuzziness, we model the present value of liabilities as a fuzzy random variable. Our results can be used by the actuary to understand the incidence of the minimum guarantee on the premium and to define the appropriate coverage strategies. A numerical example illustrates how our methodology works.

Keywords: Fuzzy volatility, Fuzzy random variables, Equity-linked policies, Life insurance, Minimum guarantee

1. Introduction

The life insurance markets have witnessed a significant shift from traditional products in which the only relevant uncertainty concerns life contingencies, to modern contracts in which the financial aspects play a crucial role. In particular, uncertainty enters the benefits not only through the time at which they (may) become due to be paid but also in their amount. A typical example in which these two effects are merged is an equity-linked policy [1]. In such a contract some or all of the premium is invested in a reference fund and benefits depend on the performance of the underlying asset (equity). Thus equity-linked policies incorporate demographic and financial uncertainty, since the date of payment of benefit is determined by demographic events and the amount of benefit is linked to financial markets.

Moreover, modern life insurance contracts also embed various kinds of options, more or less explicitly defined. The most popular implicit options are

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