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DESIGN LIFE INSURANCE PARTICIPATING POLICIES USING OPTIMIZATION TECHNIQUES

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Abstract. *This paper considers how to design a life insurance participating policy by maximizing the profit of the policy. In this type of life insurance policies, a minimum interest is credited to policyholders, and an additional interest may be credited according to the performance of a reference investment portfolio, furthermore, policyholders can sell back the contract to the insurance company before maturity and receive a surrender value. We first derive a formula to calculate the expected payments of the policy using the notion of fair valuation, we then build an optimization model to decide the minimum guarantee, participating rate and premium. Since the model built is a complicated optimization, we solve this model applying the soft approach put forward in [13]. Finally, we carry out computational experiments to check the validity of the optimization model and its solution method. The main contribution of our work is that we provide a way to decide an optimal set of contractual rates and premium for life insurance participating policies.*

Keywords: Participating policy, Minimum guarantee rate, Surrender option, Optimization, Fair value

1. **Introduction.** Among the valuable tools offered by risk management, the most valuable one is insurance. Fundamentally, insurance is used to evade risk by transferring it to another entity (insurer), in exchange for a sum of money (premium) paid by the insured in consideration of the insurer's incurring the risk of paying a larger amount upon a given contingency. Insurance has come to play an increasingly important role as a method used by individuals, families and organizations in order to be prepared to respond to emergency situations, as well as to encourage the investment in the financial market.

The contract between the insurer and the insured is referred to as insurance policy. An insurance policy stipulates all the details of the agreement between the insurer and the insured such as, risks assumed by the insurer, premium amount, term of the contract, the sum of money the insurer agrees to pay on the occurring of a particular event. When the insured event is based upon the lives of the individuals mentioned in the contract, the policy is designated as a life insurance policy. Typically these policies are divided into two major categories: protection policies and investment policies. The former is designed to provide a benefit (usually a lump sum payment) upon the death of the insured; in the latter, the main goal is to provide growth of capital.

In this paper, we scrutinize the so-called life insurance participating policy, which belongs to the investment type of policies. Participating policies are among the most common investment policies, and they are also known as with-profits policies. Participating policies have a basic amount of money assured which is determined at the inception of the contract and a minimum interest is guaranteed to the policyholder at regular intervals.