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A Generalized Modeling Framework for Guaranteed Annuity Options

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Guaranteed annuity options (GAOs) involve two main sources of uncertainty, mortality risk and interest rate risk. Although assuming independence of these two risk factors simplifies valuation of annuity- contingent derivatives, it may not always be appropriate. In this paper, we introduce a generalized pricing framework for annuity-contingent derivatives where dependence between mortality and interest rate risks are explicitly modeled, while mortality follows a continuous-time stochastic model extended from the Lee- Carter model and interest rate follows the well-known Vasicek model. Utilizing the change of measure technique, a simplified formula for the GAO price can be derived using both the forward measure associated with the bond price as numéraire, and the newly introduced concept of endowment-risk-adjusted measure. Numerical results are provided to show that the methodology proposed in this paper is more efficient and accurate.