Life Annuities with Stochastic Interest Rates

Tom Hoedemakers* † Grzegorz Darkiewicz † Jan Dhaene †‡ Marc Goovaerts †‡

Abstract

In the traditional approach to life contingencies only decrements are assumed to be stochastic. In this contribution we consider the distribution of a life annuity (and a portfolio of life annuities) when also the stochastic nature of interest rates is taken into account. Although the literature concerning this topic is already quite rich, the authors usually restrict themselves to the computation of the first two or three moments. However, if one wants to determine e.g. capital requirements using more sofisticated risk measures like Value-at-Risk or Tail Value-at-Risk, more detailed knowledge about underlying distributions is required. For this purpose, we propose to use the theory of comonotonic risks developed in Dhaene et al. (2002a and 2002b), which has to be slightly adjusted to the case of scalar products. This methodology allows to obtain reliable approximations of the underlying distribution functions, in particular very accurate estimates of upper quantiles and stop-loss premiums. Several numerical illustrations confirm the very high accuracy of the methodology. **Keywords:** life annuities, stochastic interest rates, comonotonicity, stop-loss premiums.

^{*}Corresponding author. E-mail address: Tom.Hoedemakers@econ.kuleuven.ac.be

 $^{^{\}dagger}\textsc{Department}$ of Applied Economics, K.U.Leuven, Naamsestraat 69, 3000 Leuven, Belgium

[‡]Institute of Actuarial Science, University of Amsterdam, Roeterstraat 11, 1018 WB Amsterdam, Netherlands