A matrix representation of Thiele's differential equation for multistate insurance contracts

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Abstract

A straightforward derivation of Thiele's differential equation for the reserve of a payment stream arising from multistate insurance contract governed by a discrete time Markov process is presented.

The difference equation for reserve of payments in respect of a multistate policy in the discrete time version enables us to use the matrix notation, which makes the difference equation immediately applicable for numerical calculations and can be used to construct untraditional insurance products. It is shown how the matrix form of Thiele's differential equation is relevant in order to calculate savings and risk premiums.

Numerical computations of prospective reserves, savings and risk premiums for health insurances common in practice illustrate the usefulness of the proposed approach.

Keywords: Multiple state model; Discrete time Markov process; Stochastic interest rate; Thiele's differential equation.