

Title: Pooling Functional Disability and Mortality in Long-Term Care Insurance and Care Annuities: A Matrix Approach for Multi-State Pools

Abstract:

Mortality risk sharing pools including group self-annuitisation, pooled annuity funds and tontines have been developed as an effective solution for managing longevity risk. Although they have been widely studied in the literature, these mortality risk sharing pools do not consider individual health or functional disability status nor the need for long-term care (LTC) insurance at older ages. We extend these pools to include functional disability and chronic illness and present a matrix-based methodology for pooling mortality risk across heterogeneous individuals classified by functional disability states and chronic illness statuses. We demonstrate how individuals with different health risks can more equitably share mortality risk in a pooled annuity design. A multi-state pool is formed by pooling annuitants considering both longevity and LTC risks and determining the actuarially fair benefits based on individuals' health states. Our methodology provides a general structure for a pooled annuity product that can be applied for general multi-state models. We present an extensive analysis with numerical examples using the US Health and Retirement Study (HRS) data. Our results compare expected annuity benefits for individuals in poor health to those in good health, show the effects of incorporating systematic trends and uncertainty, assess how the valuation of the expected annuity payments interacts with the assumptions used for the multi-state model and assess the impact of pool size