Life Insurance and Finance (STK4500)

Exercises 6, 26.03.2026

Problem 1 An endowment policy is issued to a life aged 40 with 60 years age at maturity. The death benefit is assumed to be 220000$, whereas the endowment amount is given by 115000$. Further, let the constant technical interest rate δ be 3% and the mortality rates be given by

$$\mu_{*\dagger}(t) = 0.0018 + 0.0004(t - 40).$$

Calculate the second moment of the present value of the benefit payments V_t^+, given $X_t = *$ for $t = 50, ..., 60$.

Problem 2 Consider a 10-years permanent disability insurance (in discrete time) issued to a healthy life aged 60. Yearly payments of 20000$ are made while the insured is disabled. A death benefit of 50000$ is paid at the end of the year of death. Assume that $\delta = 5\%$ and that the transitions rates are given as in Exercises 1, Problem 4 (i).

Compute $P(V_t^+ < u \,|X_t = \diamond)$ for $t = 67$ years and $u = 60000$$.

Problem 3 (Mathematical reserve refund guarantee) Consider a pension with refund guarantee issued to a life aged 50 years. Here the maturity of the pension is at the age of 60 and the refund guarantee is the death benefit given by the last mathematical reserve. Further, the pension payments are 15000$ per year. Assume that $\delta = 3\%$ and that

$$\mu_{*\dagger}(t) = 0.002 + 0.0005(t - 50).$$

Determine the prospective reserve of the pension and benefit payments (single premium) at the beginning of the contract.

Problem 4 Consider the disability income insurance of Exercises 5, Problem 1. Assume here that the insurance company issues a policy to a life aged 30 with maturity 35 years . A lump sum payment of 100000$ is immediately made in the case of critical illness. In addition, a death benefit of 100000$ is instantly paid, provided that the insured has not already been paid a critical illness benefit. A yearly disability pension of 75000$ is payable while the life is disabled. Further, yearly premiums are payable continuously, if the insured is healthy. Other expenses are ignored and let $\delta = 5\%$.

Calculate the yearly premiums for this policy.