Mathematics of Life Insurance 2

Sample test

Max: 15 points **Necessary: 10 points**

Unless otherwise stated, consider insurance benefit payments paid at the end of the year of death

Part 1 (3 points)

An annuity is payable continuously at the rate of

- 1 per year while both (x) and (y) are alive,
- $\frac{2}{3}$ per year while one of (x) or (y) is alive and the other is dead.

Derive expression for the annuity's present value in such a form that single life table probabilities ${}_tp_x$ and ${}_tp_y$ are used.

Part 2 (3 points)

Consider standard increasing term insurance for n years with premium paid during first m years ($m < n$). Derive the expense-loaded premium and decomposed reserve. Specify what α, β and γ stand for.

Part 3 (3 points)

Given $\mu_{j,x+t} = \frac{j}{150}$ for $j = 1, 2, 3$ and $t > 0$. Determine $E[T|J = 3]$.

Hint: Use the properties of exponential distribution to avoid integral calculation

Part 4 (2 points)

Write down the prospective formula for general net-premium (discrete) reserve. Moreover, assuming the life annuity in arrear deferred by m years with a net single premium, write down how c_k and Π_k would look like.

Part 5 (2 points)

Consider a person at age $x = 25$ and the following insurance. In the case of death until age 65, there is a single payment of 5 mil. CZK at the end of the year of death. In the case of disability until age 70, an annuity of 350,000 CZK is paid until the death. However, the payment in the case of death is not further valid. After reaching the age 70 without disablement, an annuity of 250,000 increased by 10 thousands CZK every year is paid until the death. Define a proper probabilistic model and derive a formula for the net single premium.

Part 6 (2 point)

Assume a whole life insurance with sum insured 1 payable at the moment of death. Calculate the premium rate at time t if $\Pi^s(t) = 0.03$, $V(t) = 0.5$ and $\mu_{x+t} = 0.1$.