LIFE INSURANCE
MORE EXERCISES

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EXERCISE 1

A whole life insurance is issued to a life aged 30. The sum insured is $100,000$ payable at the end of the year of death. Annual premiums of 500\$ are paid in advance throughout the duration of the policy. The technical interest rate is $i = 5\%$.

(1) Compute the net loss at times $t = 0, 1, 5, 6, 15, 16$, assuming that the policy is in force at each of these times.
(2) Compute the policy value at times $t = 0, 1, 5, 6, 15, 16$, using the Standard Ultimate Life Tables.
(3) Would the future premiums be enough to repay benefits at each of the dates $t = 0, 1, 5, 6, 15, 16$?
(4) Consider premiums paid at times $t = 0$, $t = 5$, $t = 15$. For each of them, which part is used as risk premium and which is used for saving? What can you say about the risk premium and the saving premiums at each of these times?

EXERCISE 2

An insurance company issues a whole life insurance to a life aged 40. The premium is paid in advance in annual installments throughout the duration of the policy. The insurer has expenses:

- Issue expenses are 500\$ plus 3% of the first premium
- Renewal expenses of 3% of every premium from $t = 1$
- termination expenses contingent to the payment of the benefit of 400\$

Technical interest rate is 5% per year and sum insured is $150,000\$$.

(1) Derive an expression for the gross loss at issue of this policy.
(2) Compute the gross premium according to the equivalence principle.
(3) The insurer issues 10000 independent and identical contracts. What would the gross premium be if it is calculated according to the percentile premium principle with $\alpha = 97.5\%$?

EXERCISE 3

An insurance company issues a 20 years endowment insurance to a life aged 35. The premium is paid in advance in annual installments throughout the duration of the policy. Technical interest rate is 5% per year and sum insured is $100,000\$$.

(1) Derive an expression for the net loss at issue of this policy.

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(2) Compute the gross premium according to the equivalence principle.
(3) The insurer issues 81000 independent and identical contracts. What would the gross premium be if it is calculated according to the percentile premium principle with $\alpha = 95\%$? You are given the additional information that for $x = 35$ and $n = 20$, $^2A_{x:\overline{n}|} = 0.14511$

EXERCISE 4

An insurance company issues a 20 years endowment insurance with sum insured 100000\$ to a life aged 35, paid at the earliest of the end of the year of death and 20 years. Periodic premiums are paid every year in advance throughout the duration of the policy. You are given the following information:

- technical interest rate is 5% per year;
- initial expenses are 3% of the sum insured and 20% of the first premium;
- renewal expenses 3% of the second and subsequent premiums;
- no termination expenses.

(1) Derive an expression for the gross loss at issue of this policy.
(2) Compute the gross annual premium.
(3) Compute the probability that the gross loss at issue is negative (i.e. the probability that the contract is profitable for the insurance company)

EXERCISE 5

A 20 years endowment insurance is issued to a life aged 50. The sum insured is $100,000$ payable at the end of the year of death. Annual premiums are paid in advance for at most 10 years. The technical interest rate is $i = 5\%$.

(1) Compute the net loss at times $t = 0, 1, 10, 11$, assuming that the policy is in force at each of these times.
(2) Compute the policy value at times $t = 0, 1, 10, 11$, using the Standard Ultimate Life Tables.
(3) Would the future premiums be enough to repay benefits at each of the dates $t = 0, 1, 10, 11$?
(4) Consider premiums paid at times $t = 0$, $t = 10$. For each of them, which part is used as risk premium and which is used for saving?