LIFE INSURANCE
ASSIGNMENT N. 4

PROF. KATIA COLANERI

EXERCISE 1

For a life aged 60, consider the following contracts:

- **Contract 1.** A 5-year deferred whole life annuity paid yearly, with yearly payment of $8,500\$$
- **Contract 2.** A term annuity due paid yearly with yearly payment of $7,000\$$ and maturity of 20 years
- **Contract 3.** A whole life annuity immediate paid monthly with monthly payments of $510\$$

(1) Write down the present value of the benefit for each contract.
(2) Write the actuarial values of each contract in terms of standard life insurance contracts.
(3) Suppose that the technical interest rate is $i = 5\%$, using the Standard Ultimate Life Table, compute the actuarial values of each contract.
(4) How would you explain the differences/similarities of the actuarial values of these contracts?

EXERCISE 2

A standard whole life annuity provides periodic payments of amount p every year until time K_x. A whole life annuity with guarantee of M years, guarantees the first M periodic payments of amount p and provides periodic payments of the same amount p beyond the guaranteed period, and until time K_x if the insured life is alive after the guaranteed period.

An insurance company issues a whole life annuity immediate with a guarantee of M years to a life aged x, with yearly payments of amount p.

(1) Describe the present value of the benefit and decompose it into its derministic part and its random part. What do these two part represent?
(2) Compute the actuarial value of the contract in terms of standard life insurance contracts
(3) Let $p = 6000$, $M = 20$ years, $x = 50$, $i = 5\%$. Compute the actuarial value of the whole life annuity immediate with M years guarantee, using the Standard Ultimate Life Table.
(4) Compute the actuarial value of the guarantee (i.e. the difference between a policy with the guarantee and without the guarantee).

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EXERCISE 3

A 20-year endowment insurance is issued to a life aged 50. The sum insured is $150,000\$$ and the insurance company has expenses of $1000\$$ the at the issue of the policy plus renewal expenses of 3% of each premium (contingent to premium payments), starting from $t = 0$ and final expenses paid at the time of policy liquidation of $570\$$. Premiums are paid monthly in advance throughout the duration of the policy. The technical interest rate is $i = 5\%$

(1) Determine an expression for L_0^{gross}, in terms of the premium $\bar{P}$.
(2) Determine an expression for the expected gross loss at issue.
(3) Using the Standard Ultimate Life Table evaluate the gross premium.

EXERCISE 4

An insurance company issues a whole life insurance with sum insured $250000\$$ to a life aged 60. Periodic premiums are paid every year starting at time $t = 1$ for at most 15 years. You are given the following information:

- technical interest rate is 5% per year;
- initial expenses are $500\$$;
- renewal expenses 3% of the premium, contingent to the premium payments;
- termination expenses of $350\$$.

(1) Derive an expression for the gross loss at issue of this policy.
(2) Compute the gross periodic 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)