

Stat 344 — Fall 2023

Homework Assignment 5

Due Date: Tuesday, December 5th in class

1. You are using the Equivalence Principle to price a \$100,000 20 year term policy issued to (50). You are given the following:

$$A_{50:\overline{20}|} = 0.4 \quad v = 0.95 \quad {}_{20}p_{50} = 0.9$$

- (a) Assuming that the premiums are paid annually and the death benefit is paid at the end of the year of death, calculate the annual premium. [644.69]
 - (b) Assuming that the premiums are paid monthly and the death benefit is paid at the moment of death, calculate the monthly premium. Use the UDD assumption where necessary. [56.58]
2. A person age (85) purchases a three year term policy, with gross premiums payable annually in advance and the death benefit payable at the end of the year of death. The death benefit is \$100,000 plus the sum of the gross premiums paid. You are given:

$$q_{85} = 0.2 \quad q_{86} = 0.3 \quad q_{87} = 0.4 \quad i = 10\%$$

Expenses consist of:

- 30% of the initial gross premium and 2% of renewal gross premiums
- \$500 at issue

Using the equivalence principle, calculate the gross annual premium for this policy. [70703]

3. A 30-year old purchases a 3-year endowment insurance, with \$200,000 death benefit payable at the end of the year of death, and premium P payable at the beginning of each year while the contract is in force. You are given

$$p_{30} = 0.98, \quad p_{31} = 0.97, \quad p_{32} = 0.95, \quad i = 10\%$$

- (a) Write an expression for L_0^n .
- (b) Calculate the variance of L_0^n , in terms of P . Simplify as much as possible.
- (c) Calculate the annual premium P , assuming it has been determined using the equivalence principle. [56,541.83]

4. Let L_0^n denote the present-value-of-loss random variable for a fully continuous whole life insurance policy issued to (x) . Premiums are paid at a continuous rate of 0.09 per year and a benefit of amount 2 is paid at the moment of death. If $\delta = 0.06$ and $\mu_{x+t} = 0.04$ for all t , find $Var(L_0^n)$. [1.1025]
5. An insurer issues 100 fully discrete whole life policies to independent persons age (x) . Assume that

$$d = 0.06 \quad A_x = 0.4 \quad {}^2A_x = 0.2$$

The policies are distributed as follows:

Face Amount	Number of Policies	Annual Premium Per Policy
100,000	80	5,000
400,000	20	19,000

Using a normal approximation, find the approximate probability that the present value of the insurer's profits exceeds 4,000,000. [0.00015]

6. An insurance company wants to use the Portfolio Percentile Premium Principle in order to set the annual premium amount P for whole life policies issued to x year olds. Assume that there are N insureds, all independent of one another. The death benefit for each policy will be \$500,000, payable at the end of the year of death. Assume that the insurer sets $\alpha = 0.95$ in its calculations. You are given that:

$$i = 6\% \quad A_x = 0.3051431 \quad {}^2A_x = 0.1306687$$

- (a) Find the premium P if $N = 100$. [14387.17]
 (b) Find the premium P if $N = 2500$. [12805.84]
 (c) Find the premium P if $N = 10000$. [12616.37]
 (d) Find the premium under the Equivalence Principle. [12427.81]