

STAT 472

Fall 2020

Quiz 5

November 10, 2020

1. Matthew who is (70) buys a 21 year endowment insurance. The death benefit is 400,000 and is paid at the end of the year of death. Annual premiums are paid for 21 years.

The reserves for this policy are determined using the Full Preliminary Term Method. The reserve basis is mortality that follows the Standard Ultimate Life Table and $i = 0.05$.

- a. (1 point) Calculate the net premium for the first year of this policy.

Solution:

$$P_1^{FPT} = Svq_x = (400,000)(1.05)^{-1}(0.010413) = 3966.86$$

- b. (3 points) Calculate the net premium for years after the first for this policy.

Solution:

$$P_{x+1}^{FPT} = \frac{400,000A_{71:\overline{20}|}}{\ddot{a}_{71:\overline{20}|}} = \frac{400,000(0.48039)}{10.9118} = 17,609.93$$

- c. (6 points) Calculate the Full Preliminary Term reserve at the end of 11 years.

Solution:

$$\begin{aligned} {}_{11}V &= PVFB - PVFP = (400,000)A_{81:\overline{10}|} - 17,609.93\ddot{a}_{81:\overline{10}|} \\ &= (400,000)(0.68325) - (17,609.93)(6.6517) = 156,164.05 \end{aligned}$$

2. Michael who is (65) buys a whole life policy. The death benefit is 200,000 paid at the end of the year of death. Annual premiums are payable for the life of the policy.

The gross premium is 5920.36 based on the equivalence principle.

Reserves are based on the following assumptions:

- i. Mortality follows the Standard Ultimate Life Table.
- ii. $i = 0.05$
- iii. Expenses:
 1. Commissions of 50% of premiums year 1 and 7% year 2+
 2. Issue Expense of 400 per policy at the start of year 1 only
 3. Maintenance expense of 52 per policy at the start of every year including the first year.

- a. (2 points) Calculate the net premium.

Solution:

$$P^n = \frac{(200,000)A_{65}}{\ddot{a}_{65}} = \frac{(200,000)(0.35477)}{13.5498} = 5236.53$$

- b. (2 points) Calculate the net premium reserve at the end of 10 years.

Solution:

$$\begin{aligned} {}_{10}V &= PVFB - PVFP = 200,000A_{75} - 5236.53\ddot{a}_{75} \\ &= (200,000)(0.50868) - (5236.53)(10.3178) = 47,706.48 \end{aligned}$$

or

$${}_{10}V = (200,000) \left(1 - \frac{\ddot{a}_{75}}{\ddot{a}_{65}} \right) = (200,000) \left(1 - \frac{10.3178}{13.5498} \right) = 47,705.50$$

- c. (4 points) Calculate the gross premium reserve at the end of 10 years.

Solution:

$$\begin{aligned} {}_{10}V^g &= PVFB + PVFE - PVFP^g \\ &= 200,000A_{75} + 0.07(5920.36)\ddot{a}_{75} + 52\ddot{a}_{75} - (5920.36)\ddot{a}_{75} \\ &= (200,000)(0.50868) - [(0.93)(5920.36) - 52](10.3178) = 45,463.39 \end{aligned}$$

- d. (1 point) Calculate the expense premium.

Solution:

$$P^e = P^g - P^n = 5920.36 - 5236.53 = 683.83$$

- e. (1 point) Calculate the expense reserve at the end of 10 years.

Solution:

$$V^e = V^g - V^n = 45,463.39 - 47,706.48 = -2243.09$$