Chapter 7 – Past Test and Quiz Problems – Expense Policy Value

(6 points) Conley Life Insurance Company sells a whole life policy to Andrew who is (60). The policy pays a death benefit of 100,000 at the end of the year of death. The premiums for the policy are paid annually.

You are given that:

    i. Mortality follows the Standard Ultimate Life Table.

    ii. $i = 0.05$

    iii. Commissions of 40% of premium in year 1 and 8% of premium thereafter.

    iv. Issue expenses of 400 per policy at time 0.

    v. Maintenance expenses of 30 at the beginning of each year including year 1.

    vi. Expense of paying a death claim is 300 and will be incurred at the end of the year of death.

    vii. The net premium is 1947.65.

    viii. The gross premium is 2,237.36 using the equivalence principle.

Calculate the expense premium policy value at the end of the 10th year.

Solution:

Either back into this answer by calculating gross and net policy value at time 10, or calculate directly using the expense premium.

$$_{10}V^n = 100,000 A_{70} - 1947.6520 \ddot{a}_{70}$$

$$= (100,000)(0.42818) - (1947.6520)(12.0083) = 19,430.01$$

Or

$$_{10}V^n = 100,000\left(1 - \frac{\ddot{a}_{70}}{\ddot{a}_{60}}\right) = (100,000)\left(1 - \frac{12.0083}{14.9041}\right) = 19,429.55$$

$$_{10}V^g = PVFB + PVFE - PVFP$$

$$= 100,000A_{70} + (0.08)(2237.36)\ddot{a}_{70} + 30\ddot{a}_{70} + 300A_{70} - 2237.36\ddot{a}_{70}$$

$$= (100,300)(0.42818) - [(0.92)(2237.36) - 30](12.0083) = 18,589.16$$

$$_{10}V^g = {}_{10}V^n + {}_{10}V^e$$

$$_{10}V^e = 18,589.16 - 19430.01 = -840.85$$

Ranya who is (21) purchases a whole life insurance policy with a death benefit of 100,000 payable at the end of the year of death. The policy has annual premiums. **The gross premium for this policy is 360.**

You are given:

    i.   Mortality follows that Standard Ultimate Life Table.

    ii. $i = 0.05$

    iii.   Deaths are uniformly distributed between integral ages.

a. (2 points) The net premium is 260 to the nearest 10. Calculate the net premium to the nearest 0.01.

Solution:

$$PVP = PVB$$

$$P^n \ddot{a}_{21} == 100,000 A_{21} ==> P^n = \frac{(100,000)(0.051441)}{19.9197} = 258.24$$

b. (3 points) Calculated the net premium policy value at the end of 20 years.

Solution:

$$_{20}V^n = PVFB - PVFP^n = 100,000 A_{41} - 258.24 \ddot{a}_{41}$$

$$= (100,000)(0.12665) - 258.24(18.3403) = 7928.80$$

Or

$$_{20}V^n = (100,000)\left(1 - \frac{\ddot{a}_{41}}{\ddot{a}_{21}}\right) = (100,000)\left(1 - \frac{18.3403}{19.9197}\right) = 7928.83$$

Question Continued . . .

This policy has the following expenses:

      i.   First year expense of 400 per policy plus 53% of premium

      ii.   Expense of 50 per policy plus 5% of premium in years 2+

      iii.   Claim expense of 500 incurred at the end of the year of death

Per policy expenses are incurred at the beginning of the policy year.

c. (4 points) The gross premium policy value at the end of 20 years is 7370 to the nearest 10. Calculate the policy value to the nearest 0.1. Remember that the gross premium is 360.

Solution:

$$_{20}V^g = PVFB + PVFE - PVFP$$

$$= 100,000A_{41} + 50\ddot{a}_{41} + 0.05P\ddot{a}_{41} + 500A_{41} - P\ddot{a}_{41}$$

$$= (100,500)(0.12665) - [(0.95)(360) - 50](18.3403) = 7372.96$$

d. (1 point) Calculate the expense policy value at the end of 20 years.

Solution:

$$_{20}V^e = {_{20}V^g} - {_{20}V^n} = 7372.96 - 7928.80 = -555.76$$

e. Explain why the expense policy value is negative. *[Conceptual question left for learning purposes. No conceptual questions will be asked on the quiz].*

Solution:

Expenses are front loaded. That means that the expenses in the first year are higher than the expenses in the second year and later. However, the premium for expenses is level. Initially the present value of the expense premiums is equal to the present value of the expenses. However, after the first year, the present value of future expense premiums is greater than the present value of future expenses so the policy value is negative. This occurs because the expenses in the first year are greater than the premium for expenses.