STAT 472
Fall 2019
Quiz 5

November 13, 2013

1. A fully discrete 20 year term insurance policy to (70) has a death benefit of 50,000. The net premium is calculated using the equivalence principle.

   You are given that mortality follows the Standard Ultimate Life Table with interest at 5%.

   Calculate the ${}_{10.3}V^{n}$.

   Solution:

$$P = \frac{(50,000)A^{1}_{70:\overline{20}|}}{\ddot{a}_{70:\overline{20}|}} = \frac{(50,000)(0.47091-0.17313)}{11.1109} = 1340.03$$

$${}_{10}V = PVFB - PVFP = (50,000)A^{1}_{80:\overline{10}|} - 1340.03\ddot{a}_{80:\overline{10}|}$$

$$= (50,000)(0.67674-0.33952) - 1340.03(6.7885) = 7764.21$$

$${}_{11}V = \frac{(7764.21+1340.03)(1.05)-(50,000)(0.032658)}{1-0.032658} = 8194.12$$

$${}_{10.3}V = ({}_{10}V + P)(1-0.3) + ({}_{11}V)(0.3) = (7764.17+1340.03)(0.7) + (8194.12)(0.7) = 8831.18$$

2. You are given:

   a. $1000A_{50} = 200$
   b. $1000A_{51} = 210$
   c. $v = 0.92$

   Let $1000 \cdot {}_1P^{FPT}$ be the first year net premium using the Full Preliminary Term reserve method for a fully discrete whole life policy on (50) with a death 1000. Also let $1000P_{x+1}^{FPT}$ be the net premium in years two and later using the Full Preliminary Term reserve method for a fully discrete whole life policy on (50) with a death 1000.

   Calculate $1000P_{x+1}^{FPT} - 1000 \cdot {}_1P^{FPT}$.

   Solution:

   $${}_1P^{FPT} = Svq_x$$

   $$A_{50} = vq_{50} + vp_5A_{51} \Longrightarrow 0.2 = (0.92)q_{50} + (0.92)(1-q_{50})(0.21)$$

   $$q_{50} = \frac{0.2 - (0.92)(0.21)}{(0.92)(1-0.21)} = 0.009356$$

   $${}_1P^{FPT} = Svq_x = (1000)(0.92)(0.009356) = 8.61$$

   $$1000P_{x+1}^{FPT} = \frac{1000A_{51}}{\ddot{a}_{51}} = \frac{1000(0.21)}{\frac{1-0.21}{1-0.92}} = 21.27$$

   $$1000P_{x+1}^{FPT} - 1000 \cdot {}_1P^{FPT} = 21.27 - 8.61 = 12.66$$

STAT 472
Quiz 5
Fall 2019

November 13, 2019

1. A whole life insurance policy is issued to (70) and pays a death benefit of 78,000 at the end of the year of death. The policy has level annual premiums for as long as the insured is alive.

   You are given:

   i. Mortality follows the Standard Ultimate Life Table
   ii. $i = 0.05$
   iii. The policy pays commissions of 50% for the first year and 5% thereafter.
   iv. The per policy expenses is 200.
   v. The maintenance expense for the policy is 40 at the beginning of every year including the first year.

   a. (5 points) Calculate the net benefit reserve at the end of 10 years.

   Solution

$$P = \frac{(78,000)A_{70}}{\ddot{a}_{70}} = \frac{(78,000)(0.42818)}{12.0083} = 2781.25$$

$${}_{10}V^{n} = (78,000)A_{80} - 2781.25\ddot{a}_{80}$$

$$= (78,000)(0.59293) - 2781.25(8.5484) = 22,473.33$$

   b. (9 points) The gross premium for this policy is 3200. Calculate the gross premium reserve at the end of 10 years.

   Solution:

$${}_{10}V^{g} = PVFB + PVFE - PVFP = (78,000)A_{80} + (0.05)(3200)\ddot{a}_{80} + 40\ddot{a}_{80} - 3200\ddot{a}_{80}$$

$$= (78,000)(0.59293) - (3200 - 160 - 40)(8.5484) = 20,603.34$$

c. (2 points) Calculate the expense premium and the expense reserve at the end of 10 years.

Solution

$$P^e = P^g - P^n = 3200 - 2781.25 = 418.75$$

$$_{10}V^e = _{10}V^g - _{10}V^n = 20,603.34 - 22,473.33 = -1869.99$$

d. (4 points) Explain why the expense reserve is negative.

Solution:

Most of the expenses are in the first year. On the other hand, the expense premium is level. At time zero, the present value of future expenses are equal to the present value of future expense premiums. However, after the first year, the present value of future expense premiums are greater the present value of future expenses so the reserve is negative.