STAT 475
Quiz 1
Spring 2018

January 25, 2018

Kinnick Long Term Care Insurance Company sells a three year term policy for (65). It pays 50,000 at the end of the year if a person enters a long term care facility during a year. It pays 25,000 at the end of the year if a person dies during the year. Only one benefit will be paid based on the first decrement that occurs. The policy has an annual premium payable at the beginning of each year until a benefit is paid.

Junyu, who is the chief actuary for Kinnick, wants to use a double decrement table to price this policy. Decrement (1) is entry into a long term care facility. Decrement (2) is death. He uses the following independent rates from associated single decrement tables to develop the multiple decrement table:

x	$q_x'^{(1)}$	$q_x'^{(2)}$
65	0.1	0.04
66	0.2	0.06
67	0.3	0.08

Junyu assumes that decrements are uniformly distributed is the associated single decrement tables.

Junyu also uses an interest rate of 8% in his calculations.

1. (6 points) Complete the following double decrement table. Be sure to show your work.

x	$l_x^{(\tau)}$	$d_x^{(1)}$	$d_x^{(2)}$
65	100,000	$(100,000)(0.1)(1-0.5(0.04))$ $= 9800$	$(100,000)(0.04)(1-0.5(0.1))$ $= 3800$
66	100,000 – 9800 – 3800 = 86,400 Or (100,000)(1 – 0.1)(1-0.04)	$(86,400)(0.2)(1-0.5(0.06))$ $= 16,761.6$	$(86,400)(0.06)(1-0.5(0.2))$ $= 4,665.6$
67	86,400 – 16,761.6 – 4665.6 = 64,972.8 Or (86,400)(1 – 0.2)(1-0.06)	18,712.1664	4418.1504

2. (7 points) The net premium determined using the equivalence principle is 9300 to the nearest 100. Calculate it to the nearest 1.

Solution:

$PVP = PVB$

$$P(100,000 + 86,400v + 64,972.8v^2) =$$
$$50,000(9800v + 16,761.6v^2 + 18,712.1664v^3) + 25,000(3800v + 4665.6v^2 + 4418.1504v^3)$$

$P = 9293.80$

3. (7 points) Kinnick decides to charge a premium of 10,000. Let L_0 be the loss at issue for this insurance based on the premium of 10,000. Assume that there are no expenses. Calculate the $E[L_0]$.

Solution:

$E[L_0] = PVB - PVP =$

$$50,000\left(\frac{9800v + 16,761.6v^2 + 18,712.1664v^3}{100,000}\right) + 25,000\left(\frac{3800v + 4665.6v^2 + 4418.1504v^3}{100,000}\right)$$

$$-(10,000)\left(\frac{100,000 + 86,400v + 64,972.8v^2}{100,000}\right)$$

$= -1664.54$

Or, since the $E[L_0] = 0$ when $P = 9293.80,$ then $10,000 - 9293.80 = 706.20$ is the profit in each premium. Therefore, the expected loss is the negative expected profit.

$$-(706.20)\left(\frac{100,000 + 86,400v + 64,972.8v^2}{100,000}\right) = -1664.54$$

4. (Bonus – 5 points) The cost of a month's stay in the Long Term Care Facility is about 8000. Why should Kinnick be concerned about selling this policy? Suggest a change to the benefits that would help minimize the risk with this policy.

   Solution:

   The risk is one of anti-selection. Nursing home entry is often an elective process. Therefore, someone could buy this policy and pay a premium of 10,000. Additionally, they could enter a nursing home without real need for one month and pay the cost of the nursing home which is 8000. In return, the policy would pay the insured 50,000 so they would be 32,000 better off.

   One way to handle this anti-selection would be to pay the benefit monthly. For example, the policy could pay 5000 for each month that the person was in the nursing home. This might change the premium slightly but would not allow the insured to have a financial gain from entering the nursing home.

   There are many other actions that Kinnick could take to address the anti-selection. This is just one of the possibilities.