MAP 4176 / 5178 Name:____________________________

Test 2 Date: January 25, 2017

Show all work for full credit, use correct notation., and clearly mark your answer.

1. Using ILT assumptions determine

   (a) (10 points) the expected present value for a whole-life insurance of 1000 issued to independent lives, ages 30 and 40, with benefit payable at the end of the year of the first death. $Z = 1000\, Z_{30:40}$

   $$EPV = 1000\, A_{30:40} = 195.84$$

   (b) (10 points) the variance of the present value random variable for the insurance in part (a)

   $$Var(Z) = 1000^2 \left[{}^2A_{30:40} - (A_{30:40})^2 \right]$$

   $$= 1000^2 \left(.06672 - (.19584)^2 \right) = 28367$$

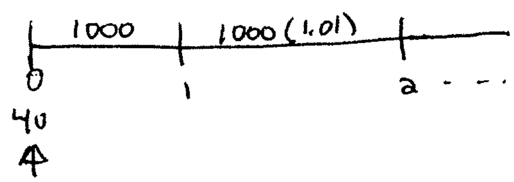
2. For a discrete whole life insurance issued to (40), you are given:

   (i) The death benefit in the first year is 1000 and increases by 1% each year.

   (ii) Mortality follows the Illustrative Life Table

   (iii) $i = 0.0706$

   Determine the expected present value of the death benefit.



$$EPV \overset{VEP}{=} 1000\, v_{.0706}\, q_{40} + 1000(1.01)\, v^2_{.0706} \cdot {}_{1|}q_x + \cdots$$

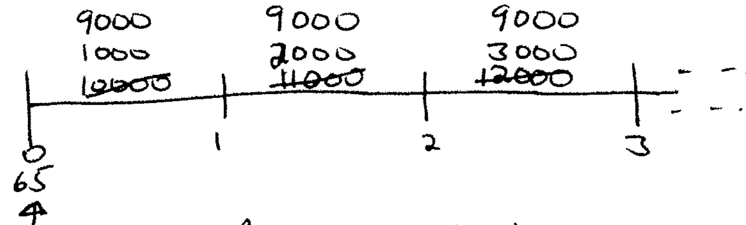
$$= \frac{1}{1.01} \Big[1000 \underbrace{(1.01)\, v_{.0706}}_{= v_{.06}} q_{40} + 1000 \underbrace{(1.01)^2 \cdot v^2_{.0706}}_{= v^2_{.06}} \cdot {}_{1|}q_x + \cdots \Big]$$

$$\therefore EPV = \frac{1}{1.01} \cdot \left[1000\, A_{40 \,@\, i=.06} \right] = \frac{161.32}{1.01} = 159.72$$

3. For a discrete whole life insurance on (65), you are given:

(i) The death benefit in the first year is 10,000 and increases by 1,000 each year.
(ii) $A_{65} = 0.42898$
(iii) $(IA)_{65} = 6.16761$

Determine the actuarial present value of the insurance benefit.



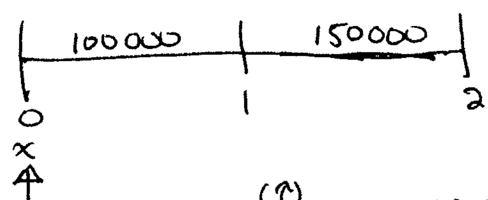
$$APV = 9000 A_{65} + 1000 (IA)_{65} = 10{,}028.43$$

4. For a special discrete 2-year term insurance issued to (x), you are given:

(i) The death benefit is 100,000 in the first year and 150,000 in the second year.
(ii) The insurer is considering adding a double indemnity clause which, if adopted, will double the death benefit if death occurs by accident.
(iii) Decrement 1 is death by accident, and decrement 2 is death by non-accident.
(iv) $q_{x+n}^{(j)} = 0.01 \cdot j \cdot (n+1)$ for $n = 0,1$ and $j = 1,2$ $\quad q_x^{(1)} = .01 \quad q_x^{(2)} = .02 \Rightarrow q_x^{(\tau)} = .03$
(v) $v = 0.95$ $\quad q_{x+1}^{(1)} = .02 \quad q_{x+1}^{(2)} = .04 \Rightarrow q_{x+1}^{(\tau)} = .06$

Determine the increase in the net single premium if the double indemnity clause is adopted.

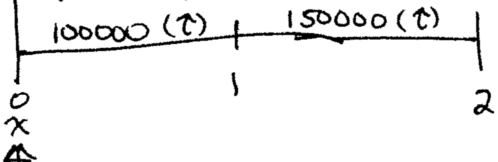
Without the double indemnity clause:



$$SNP = 100000\, v\, q_x^{(\tau)} + 150000\, v^2 \cdot {}_{1|}q_x^{(\tau)} = 100000(.95)(.03) + 150000(.95)^2(.97)(.06)$$

$$\Rightarrow SNP = 10728.825$$

With the double indemnity clause:



$$SNP = 10728.825 + 100000\, v\, q_x^{(1)} + 150000\, v^2 \cdot {}_{1|}q_x^{(1)}$$

$$\therefore \Delta = 100000\, v\, q_x^{(1)} + 150000\, v^2 \, {}_{1|}q_x^{(1)} = 100000\, v\, q_x^{(1)} + 150000\, v^2 \cdot p_x^{(\tau)} \cdot q_{x+1}^{(1)}$$

$$= 100000(.95)(.01) + 150000(.95)^2(.97)(.02) = 3576.275$$