

STAT 472
Fall 2021
Quiz 6
 November 30, 2021

1. For a fully discrete whole life insurance policy of 2000 on (40), you are given:
- i. The gross premium is calculated using the equivalence principle.
 - ii. Expenses, payable at the beginning of the year, are:

	% of Premium	Per Policy
First Year	30%	40
Renewal Year	5%	15

- iii. Mortality follows the Standard Ultimate Life Table.
- iv. $i = 0.05$
- v. "Fully discrete" means the death benefit is paid at the end of the year of death and premiums are paid at the beginning of the year.

- a. (4 points) Calculate the Gross Premium.

$$PVP = PVB + PVE$$

$$P\ddot{a}_{40} = 2000A_{40} + 0.25P + 0.05P\ddot{a}_{40} + 25 + 15\ddot{a}_{40}$$

$$P[0.95\ddot{a}_{40} - 0.25] = 2000A_{40} + 25 + 15\ddot{a}_{40}$$

$$P = \left(\frac{2000(0.12106) + 25 + 15(18.4578)}{0.95(18.4578) - 0.25} \right) = \left(\frac{543.987}{17.8491} \right) = 31.47$$

- b. (6 points) Calculate ${}_{10}V^e$ (the expense reserve at the end of policy year 10).

$${}_{10}V^e = {}_{10}V^s - {}_{10}V^n$$

$$P^n = \left(\frac{2000A_{40}}{\ddot{a}_{40}} \right) = \left(\frac{2000(0.12106)}{18.4578} \right) = 13.12$$

$${}_{10}V^n = PVFB - PVFP^n$$

$$= 2000A_{50} - 13.12\ddot{a}_{50} = 2000(0.18931) - 13.12(17.0245) = 155.26$$

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

$$= 2000A_{50} + 0.05(31.47)\ddot{a}_{50} + 15\ddot{a}_{50} - 31.47\ddot{a}_{50}$$

$$= (2000)(0.18931) + (.05(31.47) + 15 - 31.47)(17.0245) = 125.01$$

$${}_{10}V^e = {}_{10}V^s - {}_{10}V^n = 125.01 - 155.26 = -30.25$$

2. (10 points) You are given:

- i. $500A_{40} = 100$
- ii. $500A_{41} = 105$
- iii. $d = 0.08$
- iv. Death benefit is 500 paid at the end of the year of death.
- v. The Full Preliminary Term reserve method is used to calculate reserves.

Calculate $500(P_{x+1}^{FPT}) - 500({}_1P^{FPT})$

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

$$A_{40} = vq_{40} + vp_{40}A_{41} \implies 0.2 = (1-0.08)q_{40} + (1-0.08)(1-q_{40})\left(\frac{105}{500}\right)$$

$$q_{40} = \frac{0.2 - (0.92)(0.21)}{(0.92)(1-0.21)} = 0.009356$$

$${}_1P^{FPT} = Svq_x = (500)(0.92)(0.009356) = 4.30376$$

$$P_{x+1}^{FPT} = \frac{500A_{41}}{\ddot{a}_{41}} = \frac{500(0.21)}{\frac{1-0.21}{0.08}} = 10.63291$$

$$500P_{x+1}^{FPT} - 500 \cdot {}_1P^{FPT} = 500(10.63291 - 4.30376) = 3,164.58$$

or

$$10.63291 - 4.30376 = 6.32915$$