MAP 4176 / 5178 Name: KEY
Test 1 Date: January 16, 2019

Each problem is worth 10 points. Show all work for full credit, and use correct notation. Simplify answers completely. See other side for additional problems.

For Numbers 1 through 4, use the actuarial assumptions in the L-TAM tables to determine the actuarial present value of each annuity described:

1. a 20-year deferred whole life annuity due of 5,000 issued to (25)

$$5000\ {}_{20|}\ddot{a}_{25} = 5000\left(\ddot{a}_{25} - \ddot{a}_{25:\overline{20|}}\right)$$
$$= 5000\,(19.7090 - 13.0506)$$
$$= 5000 \cdot 6.6584$$
$$= \boxed{33{,}292}$$

2. a 10-year temporary annuity immediate of 10,000 issued to (35)

$$10000\ a_{35:\overline{10|}} = 10000\left(\ddot{a}_{35:\overline{10|}} - 1 + {}_{10}E_{35}\right)$$
$$= 10000\,(8.0926 - 1 + 0.61069)$$
$$= 10000 \cdot 7.70329$$
$$= \boxed{77{,}032.90}$$

3. a 15-year temporary annuity due of 1,000 issued to (30)

$$1000\ \ddot{a}_{30:\overline{15|}} = 1000\left(\ddot{a}_{30} - {}_{15}E_{30} \cdot \ddot{a}_{45}\right)$$
$$= 1000\left(\ddot{a}_{30} - v^{15}\,\frac{l_{45}}{l_{30}} \cdot \ddot{a}_{45}\right)$$
$$= 1000\left(19.3834 - (1.05)^{-15} \cdot \frac{99{,}033.9}{99{,}727.3} \cdot 17.8162\right)$$
$$= 1000\,(19.3834 - 8.5103)$$
$$= \boxed{10{,}873.09}$$

4. a 20-year certain-and-life annuity due issued to (20) with annual payments of 3,000

$$3000\, \ddot{a}_{\overline{20:\overline{20|}}} = 3000(\ddot{a}_{20} + \ddot{a}_{\overline{20|}} - \ddot{a}_{20:\overline{20|}})$$

$$= 3000(19.9664 + 13.0853 - 13.0559)$$

$$= 3000 \cdot 19.9958$$

$$= \boxed{59{,}987.46}$$

5. Using L-TAM mortality and an annual effective interest rate of 6% for the first two years, and 5% thereafter, determine the actuarial present value of a whole life annuity due with annual payments issued to (28) that pays 100 in the first year, 200 in the second year, and 300 per year for each year thereafter.

$$APV = 100 + 200 \cdot (1.06)^{-1} \cdot \frac{l_{29}}{l_{28}} + 300 \cdot (1.06)^{-2} \cdot \frac{l_{30}}{l_{28}} \cdot \ddot{a}_{30}$$

$$= 100 + \frac{200}{1.06} \cdot \frac{99{,}757.7}{99{,}787.2} + \frac{300}{1.06^2} \cdot \frac{99{,}727.3}{99{,}787.2} \cdot 19.3834$$

$$= 100 + 188.62 + 5{,}172.24$$

$$= \boxed{5{,}460.86}$$