MAP 4176 / 5178 Name:______________________________

Test 5 Date: February 13, 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.

1. Determine an expression using single life and joint life statuses for the actuarial present value of a continuous insurance, based on independent lives $(x)$ and $(y)$, with death benefit as follows:
    100 is paid when $(x)$ dies if $(x)$ dies first
    250 is paid when $(x)$ dies if $(x)$ dies second
    150 is paid when $(y)$ dies if $(y)$ dies first
    300 is paid when $(y)$ dies if $(y)$ dies second

$APV = 250A_x + 300A_y - 150A_{xy}$

2. Use the Standard Ultimate Life Table for L-TAM actuarial assumptions, and assume a uniform distribution of deaths between integer ages, to calculate the actuarial present value of a 10-year deferred whole life insurance of 500,000 issued to (20) with benefit payable at the moment of death.

$APV = 500000\,{}_{10|}\bar{A}_{20} = 500000 \cdot {}_{10}E_{20} \cdot \frac{i}{\delta} \cdot A_{30} = 24{,}149$

3. Use the Standard Ultimate Life Table for L-TAM actuarial assumptions, and use the claims acceleration approach, to calculate the APV of a 20-year endowment insurance of 100,000 issued to (20) where the death benefit is paid at the moment of death.

$APV = 100000 \cdot \bar{A}_{20:\overline{20|}} = 100000 \cdot \left(\bar{A}_{\substack{1\\20:\overline{20|}}} + {}_{20}E_{20}\right)$

$= 100000 \cdot \left((1+i)^{\frac{1}{2}} \cdot \left(A_{20:\overline{20|}} - {}_{20}E_{20}\right) + {}_{20}E_{20}\right) = 37{,}839$

4. A 25-year deferred whole life insurance of 200,000 is issued to a 40-year old. The benefit is payable at the moment of death. Determine the APV of the insurance policy using an annual effective interest rate of 6% and $DML(\omega = 105)$ mortality.

$$APV = 200000 \cdot {}_{25}E_{40} \cdot \bar{A}_{65} = 200000 \cdot \left(v_{0.06}^{25} \frac{40}{65}\right) \cdot \frac{1}{40} \bar{a}_{\overline{40|}} = 11{,}107$$

5. A 10-year deferred, 20-year term, continuous insurance of 30,000 is issued to $(x)$. In particular, a death benefit of 30,000 is paid at the moment of death if $(x)$ dies between the ages of $x + 10$ and $x + 30$. Determine the actuarial present value of this insurance policy assuming $\mu = 0.02$ and $\delta = 0.04$.

$$APV = 30000 \cdot \left({}_{10}E_x \cdot \bar{A}_{x+10} - {}_{30}E_x \cdot \bar{A}_{x+30}\right)$$
$$= 30000 \cdot \left(e^{-10(\mu+\delta)} \cdot \frac{\mu}{\mu+\delta} - e^{-30(\mu+\delta)} \cdot \frac{\mu}{\mu+\delta}\right)$$
$$= 30000 \cdot \frac{\mu}{\mu+\delta} \cdot \left(e^{-10(\mu+\delta)} - e^{-30(\mu+\delta)}\right) = 3{,}835$$

(There are many other correct ways to get to the final answer of 3,835.)