LTAM Spring 2019 Multiple Choice Solutions

1. Answer C

$$_{12}p_{[68]} = {}_2p_{[68]}\ {}_{10}p_{70} = (1-0.75q_{68})(1-0.75q_{69})_{10}p_{70} = 0.8197$$

2. Answer B

3. Answer E

$$\left.\frac{d}{dt}{}_tq_{50}\right|_{t=10} = {}_{10}p_{50}\,\mu_{60} = 0.00316$$

4. Answer A

$$_2p_x^{02} = p_x^{02} + p_x^{00}\,p_{x+1}^{02} + p_x^{01}\,p_{x+1}^{12} = 0.295$$

$$N^d \sim bin(100, 0.295) \Rightarrow SD[N^d] = \sqrt{N^d(0.295)(0.705)} = 4.6$$

5. Answer A

$$p_x^{01} = 0.0546 \quad p_x^{0\bullet} = 0.56098 \quad p_x^{00} = 0.43912$$

$$_{0.6}p_x^{01} = \int_0^{0.6} e^{-t\mu^{0\bullet}}\mu^{01}dt = \frac{\mu^{01}}{\mu^{0\bullet}}\left(1-e^{-0.6\mu^{0\bullet}}\right) = \frac{\mu^{01}}{\mu^{0\bullet}}\left(1-\left(p_x^{00}\right)^{0.6}\right)$$

$$\text{Also } {}_1p_x^{01} = \frac{\mu^{01}}{\mu^{0\bullet}}\left(1-\left(p_x^{00}\right)\right) \Rightarrow \frac{\mu^{01}}{\mu^{0\bullet}} = \frac{p_x^{01}}{p_x^{0\bullet}} = 0.09733$$

$$\Rightarrow {}_{0.6}\ p_x^{01} = 0.09733(1-0.43912^{0.6}) = 0.03793$$

6. Answer B

$$\hat{H}(3.2) = \hat{H}(2.1) + \frac{2}{r} \Rightarrow r = 15$$

7. Answer C

$$p(x,0) = 0.6 \quad p(x+1,1) = 1-0.5\times 0.85 = 0.575 \quad p(x+2,2) = 1-0.6\times 0.8^2 = 0.616$$

$$\Rightarrow \Pr = 0.2125$$

8. Answer D

Year of Death	PV Death Benefit
1	47,619
2	45,351
3	43,192
4+	0

Prob is $_2p_{[60]} = 0.97$

9. Answer C

EPV benefits: $25000vp_x^{01} + 25000v^2{}_2p_x^{01}$

$p_x^{01} = 0.06 \quad {}_2p_x^{01} + p_x^{01}p_{x+1}^{11} + p_x^{00}p_{x+1}^{01} = 0.0792$

$EPV = 1500v + 1980v^2 = 3000$

$$\Rightarrow v = \frac{-15000 \pm \sqrt{1500^2 + 4 \times 3000 \times 1980}}{2 \times 1980} = \frac{1}{1.1}$$

$\Rightarrow i = 10\%$

10. Answer B

11. Answer E

$$EPV \text{ benefits } = 500000\left(q_{38}^{*} + p_{38}^{*}q_{39}^{*}v^2 +_2 p_{38}^{*}v^2 A_{40:\overline{20|}}^{1}\right) = 7947$$

where $q_{38}^{*} = 0.001389 \quad q_{39}^{*} = 0.001479$

EPV loss at issue $= 7947 - 7245 = 702$

12. Answer C

$$\ddot{a}_{\overline{50:50:20|}} = 2\ddot{a}_{50:\overline{20|}} - \ddot{a}_{50:50:\overline{20|}} = 13.0765$$

where $\ddot{a}_{50:50:\overline{20|}} = \ddot{a}_{50:50} - \left(\frac{l_{70}}{l_{50}}\right)^2 v^{20}\ddot{a}_{70:70} = 12.609$

13. Answer D

EPV Premiums less expenses: $P\left((0.95)\ddot{a}_{45:\overline{20|}} - 0.3\right) = 11.9921P$

EPVAnnuity + Other Expenses: $75{,}000{}_{20}E_{45}\,\ddot{a}_{65} + 150\ddot{a}_{45} - 100\ddot{a}_{45:\overline{20|}} + 1950 = 369{,}112$

$\Rightarrow P = 30{,}780$

14. Answer E

$L_0 = Sv^H + 0.05S - 0.95G\ddot{a}_H + 0.1G$

where $H = \min(K_{50} + 1,\ 10); \quad S = 300{,}000; \quad G = 26{,}470.$

$$\Rightarrow L_0 = Sv^H - 0.95G\left(\frac{1 - v^H}{d}\right) + 17{,}647 = 828{,}077v^H - 510{,}430$$

$$\Rightarrow \Pr[L_0 < 0] = \Pr[v^H < 0.6164] = \Pr[H > 9.9]$$
$$= \Pr[H = 10] = {}_9p_{50} = 0.9833$$

15. Answer B

$P\bar{a}_{50}^{00} + 0.5P\,\bar{a}_{50}^{01} = 100{,}000\bar{A}_{50}^{02}$

$\Rightarrow P(12.7625) = 33{,}126 \Rightarrow P = 2{,}603$

16. Answer D

$${}_{10}V = SA_{60:\overline{10}|} - (0.95G - 100)\,\ddot{a}_{60:\overline{10}|} = 789,652$$

17. Answer E

$$L_5 = Sv^{T_{60}} - P\overline{a}_{\overline{T_{60}}|} = \left(S + \frac{P}{\delta}\right)v^{T_{60}} - \frac{P}{\delta}$$

$$Var[L_5] = \left(S + \frac{P}{\delta}\right)^2 \left({}^2\overline{A}_{60} - \overline{A}_{60}^2\right)$$

$${}^2\overline{A}_{60} = \frac{(1.05)^2 - 1}{2\delta}\,{}^2A_{60} = 0.113802; \quad \overline{A}_{60} = \frac{i}{\delta}A_{60} = 0.29748$$

$$\Rightarrow SD[L_5] = 130,744\sqrt{0.025308} = 20,800$$

18. Answer D

$${}_4V^e = 0.05G + 8 - P^e = -15.78 \Rightarrow P^e = 71.80$$

$$P^n = P^g - P^e = 888.65$$

19. Answer A

$$S_{45} = 65,000; \quad FAS = \frac{S_{62} + S_{63} + S_{64}}{3} = S_{45}\frac{(1.025)^{17} + (1.025)^{18} + (1.025)^{19}}{3}$$

$$= 101,398$$

$$NC = 0.015 \times {}_{20}\,p_{45}^{(\tau)} \times v^{20} \times (FAS)_{65} \times \ddot{a}_{65} = 1362$$

20. Answer C

$$EPVTHB = 3000(1+j)^5\,\ddot{a}_B(65,0)\,v^5\,{}_5p_{60} = 85,374$$

$$NC = \frac{85,374}{35} = 2440$$