ACTEX MLC Study Manual

Spring 2014 Edition

Errata

2 May 2014

C1-19 (e) line 3: $\dfrac{(70-10)(10+220)}{15400} - \dfrac{(70-20)(20+220)}{15400} = 0.89610 - 0.77922 = 0.11688$

C5-9 line −3 to −1:

$$\bar{A}^{1}_{22:\overline{0.5|}} = \int_0^{0.5} 1.06^{-t}\, {}_t p_{22}\, \mu_{22+t}\, \mathrm{d}t = \int_0^{0.5} 1.06^{-t} q_{22}\, \mathrm{d}t = q_{22} \int_0^{0.5} \frac{1}{1.06^t}\, \mathrm{d}t = 0.0011 \bar{a}_{\overline{0.5|}},$$

where $\bar{a}_{\overline{0.5|}} = \dfrac{1-1.06^{-0.5}}{\ln 1.06} = 0.492786607$. So, $\bar{A}^{1}_{22:\overline{0.5|}} = 0.000542065$.

C5-10 line 2: $\ldots = \dfrac{0.019776623 - 0.000542065}{0.970751655} = 0.014788509$

line 4: $\bar{A}_{22.5:\overline{20.5|}} = 0.306195466$

line 5: $\bar{P}(\bar{A}^{1}_{22.5:\overline{20.5|}}) = 0.014788509 / 11.90694241 = 0.0012420$

line 6: $\bar{P}(\bar{A}_{22.5:\overline{20.5|}}) = 0.306195466 / 11.90694241 = 0.0257157$

C6-77 line −3: $0.9947\,{}_{1.5}V$, line −1: $0.99467176\,{}_2V$

C7-60 11(d) final answer: 17616.68

C7-65 19(b)(i) $\dfrac{\mathrm{d}}{\mathrm{d}t}\,{}_tV = (\ln 1.06)\,{}_tV - (P + 200 - {}_tV)\mu_{65+t}$

(b)(ii) $\dfrac{\mathrm{d}}{\mathrm{d}t}\,{}_tV = (\ln 1.06) \times 11334.98 - (P + 200 - 11334.98) \times 0.0215 = 658.5$

So the reserve is approximately equal to 11334.98 + 658.5 / 3 = 11554.5

C7-74 line -1: the answer is (C)

C8-42 lines 1 - 3: Replace with $\mathrm{f}_{x,J}(10,1) = {}_{10}p_{40}^{(\tau)} \mu_{50}^{(1)}$, $\mathrm{f}_x(10) = {}_{10}p_{40}^{(\tau)} \mu_{50}^{(\tau)}$.

So, $\mathrm{f}_{J|T}(1|10) = \mu_{50}^{(1)} / \mu_{50}^{(\tau)} = 2/5$.

C8-43 #9 line 1: $-\dfrac{\mathrm{d}}{\mathrm{d}t}\ln({}_t p'^{(1)}_{40})$

C9-12 Line 4 after "Gain by Source": delete "in" after N

C9-14 Top three lines: Note that the decomposition here is the total profit from withdrawal and mortality. In the rare occasion that you are asked to further break down the gain into gain from mortality and then gain from withdrawal, then you have to make specific assumption. A reasonable one is to suppose that deaths occur throughout the year continuously and withdrawal only happens at the end of the year, then we can proceed as follows:

Gain from mortality:
We assume that the independent rate of withdrawal follows the assumption. This means that while $q'^{(w)}_{x+h}$ follows the assumption, the (dependent) withdrawal probability $\hat{q}^{(w)}_{x+h} = (1-\hat{q}^{(d)}_{x+h})q'^{(w)}_{x+h}$ would still differ from expected (which is $q^{(w)}_{x+h} = (1-q^{(d)}_{x+h})q'^{(w)}_{x+h}$). As a result, $\hat{p}^{(\tau)}_{x+h} = 1-\hat{q}^{(w)}_{x+h} - \hat{q}^{(d)}_{x+h}$ would also change.

$$\begin{aligned}\mathrm{Pr}^{d}_{h+1} &= -N[b^{(w)}_{h+1}\hat{q}^{(w)}_{x+h} + (b^{(d)}_{h+1}+\hat{E}^{(d)}_{h+1})\hat{q}^{(d)}_{x+h} + \hat{p}^{(\tau)}_{x+h}\,{}_{h+1}V] + N[b^{(w)}_{h+1}q^{(w)}_{x+h} + (b^{(d)}_{h+1}+\hat{E}^{(d)}_{h+1})q^{(d)}_{x+h} + p^{(\tau)}_{x+h}\,{}_{h+1}V] \\ &= Nb^{(w)}_{h+1}(q^{(w)}_{x+h}-\hat{q}^{(w)}_{x+h}) + N(b^{(d)}_{h+1}+\hat{E}^{(d)}_{h+1})(q^{(d)}_{x+h}-\hat{q}^{(d)}_{x+h}) + N(p^{(\tau)}_{x+h}-\hat{p}^{(\tau)}_{x+h})\,{}_{h+1}V \\ &= -N(b^{(w)}_{h+1} - {}_{h+1}V)(\hat{q}^{(w)}_{x+h}-q^{(w)}_{x+h}) - N(b^{(d)}_{h+1}+\hat{E}^{(d)}_{h+1} - {}_{h+1}V)(\hat{q}^{(d)}_{x+h}-q^{(d)}_{x+h}) \\ &= N(b^{(w)}_{h+1} - {}_{h+1}V)(\hat{q}^{(d)}_{x+h}-q^{(d)}_{x+h})q'^{(w)}_{x+h} - N(b^{(d)}_{h+1}+\hat{E}^{(d)}_{h+1} - {}_{h+1}V)(\hat{q}^{(d)}_{x+h}-q^{(d)}_{x+h})\end{aligned}$$

Gain from withdrawal:
Now mortality follows the experience. So

$$q^{(w)}_{x+h} = (1-\hat{q}^{(d)}_{x+h})q'^{(w)}_{x+h}, \text{ and } p^{(\tau)}_{x+h} = (1-\hat{q}^{(d)}_{x+h})\,p'^{(w)}_{x+h}.$$

$$\begin{aligned}\mathrm{Pr}^{w}_{h+1} &= -N[b^{(w)}_{h+1}\hat{q}^{(w)}_{x+h} + (b^{(d)}_{h+1}+\hat{E}^{(d)}_{h+1})\hat{q}^{(d)}_{x+h} + \hat{p}^{(\tau)}_{x+h}\,{}_{h+1}V] + N[b^{(w)}_{h+1}q^{(w)}_{x+h} + (b^{(d)}_{h+1}+\hat{E}^{(d)}_{h+1})\hat{q}^{(d)}_{x+h} + p^{(\tau)}_{x+h}\,{}_{h+1}V] \\ &= Nb^{(w)}_{h+1}(q^{(w)}_{x+h}-\hat{q}^{(w)}_{x+h}) + N(p^{(\tau)}_{x+h}-\hat{p}^{(\tau)}_{x+h})\,{}_{h+1}V \\ &= Nb^{(w)}_{h+1}(q^{(w)}_{x+h}-\hat{q}^{(w)}_{x+h}) + N(1-\hat{q}^{(d)}_{x+h}-q^{(w)}_{x+h}-1+\hat{q}^{(d)}_{x+h}+\hat{q}^{(w)}_{x+h})\,{}_{h+1}V \\ &= -N(b^{(w)}_{h+1} - {}_{h+1}V)(\hat{q}^{(w)}_{x+h}-q^{(w)}_{x+h})\end{aligned}$$

C9-42 #16(b)(i) (110.68888 – 138.361)(2 – 1.5) × 0.12 –(1010 – 138.361) × (2 – 1.5) = –437.4801

(b)(iii) Here $q^{(w)}_{x+h}$ = (1 – 0.02) × 0.12 = 0.1176

So the gain is –(110.68888 – 138.361)(10 – 11.76) = –48.7029

C10-50 #17: statement (ii) delete "≤ 60"

C11-8 line –5: change the last word from "he" to "the".

C11-30 lines –2, –3, –4: all T_{xy} should be $T_{\overline{xy}}$, and also change all t in $\dfrac{{}_tp_x\,{}_tp_y}{{}_tp_{\overline{xy}}}$ to k.

Do the same for lines 2 to 5 on page 11.

C13-28 #13 line 5: expected to earn

C13-37 (b) line 3 to 4 (before "So")

$$\begin{aligned}{}_0L &= 10000v^{(K+1)\wedge 3} + 30 + 0.03P(\ddot{a}_{\overline{(K+1)\wedge 3|}} - 1) - P\ddot{a}_{\overline{(K+1)\wedge 3|}} \\ &= \left(10000 + \frac{0.97P}{d}\right)v^{(K+1)\wedge 3} + 30 - \frac{0.97P}{d} - 0.03P\end{aligned}$$

last line: P = 2905.744

C13-38 Line 1: using 20% interest

C15-30 #2 1st line: change "is" to "his"

C15-35 line 9: Illustrative "Life" Table

C15-37 #2 2nd line: change 1/3 to 2/3, 6th line: $28000 \times 1.03^{33} = \$74{,}265.39$
(b) (not (c)) 1st to 4th line: change 31 to 32, 32 to 33, 33 to 34, 34 to 35
last line

$$\frac{2}{3}\times 28000\times 1.03^{32} + 28000\times 1.03^{33} + 28000\times 1.03^{34} + \frac{1}{3}\times 28000\times 1.03^{35}$$

= \$225,089.663.

The yearly average is \$75,029.89.

C15-39 The projected final year salary becomes $S\,\frac{s_{60}}{s_{24.5}} = 1.05^{35.5}S$.

Thus, the replacement ratio is $\frac{4.970521}{1.05^{35.5}} = 87.97\%$.

C16-1 line 3: she were a stockholder

C16-2 equation at the middle: delete " $N[$ ", and change the sign for $p_{x+h\ h+1}V$ from + to –.

C16-6 line 1: change 1235.2 to 1507.917, line 2: change 1111.7 to 1357.13

C16-7 (d) uses 9% as the (delete "to")

C16-11 line –2: that when we move

C16-19 #6 Table: Cumulative face amount … years 1 - 19

S-1, S-11 For #22, the correct choice is (C).

T1-10 #20. (v) change 2021 to 2020.

T2-10 #19 Change the choices as follows: 106,000, 116,000, …, 146,000

T2-11 last sentence in question: year 21

T2-23 #19 replace the numerical answer with 115977.25

T4-15 #2 line -3: change $E(T_{50:60})$ to $E(T_{40:60})$

T4-22 #17: Change the solution as

$$\ddot{a}_{60} = 1 + v p_{60} \ddot{a}_{61}$$

and hence $\ddot{a}_{61} = \frac{(12.18-1)\times e^{0.05}}{0.98} = 11.9931$.

Then $A_{61} = 1 - d\,\ddot{a}_{61} = 1 - (1-v)\,\ddot{a}_{61} = 1 - (1 - e^{-0.05}) \times 11.9931 = 0.41509$.

By claims accelerated approach, $A_{61}^{(6)} = (1+i)^{\frac{5}{12}} A_{61} = (e^{0.05})^{\frac{5}{12}} \times A_{61} = 0.4238294$.

As a result, $\ddot{a}_{61}^{(6)} = \frac{1 - A_{61}^{(6)}}{d^{(6)}} = \frac{1 - 0.4238294}{6(1 - e^{-0.05/6})} = 11.5715$.

T5-18 line 2: change ≤ in the expression for $f_x(t)$ to ≥

T6-8 #15: change (III) to "less" likely to come ….

T6-10 Table: Cumulative face amount … years 1 – 19

T6-14 Answer Key: 15 change to (D), 16 change to (A)

T6-19 #15: Change Answer key to (D). Last sentence: Statement III is TRUE.
#16: Change Answer key to (A).

T6-20 line 2: strictly <u>de</u>creasing of

T6-24 Last line of #24: $q_{46} = 0.00431$, we get $1000\,(I\bar{A})^{1}_{45:\overline{2}|} = 7.9052$.