Errata and Updates for ASM Exam MLC (Fifteenth Edition Third Printing) Sorted by Page

[1/6/2017] On page 49, in exercise 3.36, on the second line, change $0 \le x \le 1$ to $0 \le x < 1$.

[12/30/2016] On page 99, in the solution to exercise 5.2, on the second and fourth lines, in the integral in the exponent, change μ_u to μ_{25+u}.

[1/10/2017] On page 103, in the solution to exercise 5.21, on the sixth line, replace "$u = e^{-0.01t}$ and $\mathrm{d}v = \left(\frac{60-t}{50}\right)\mathrm{d}t$." with "where $u = \left(\frac{60-t}{50}\right)$ and $\mathrm{d}v = e^{-0.01t}\,\mathrm{d}t$."

[7/25/2017] On page 194, in Example 10H, on the third line, change $A^{(2)}_{\substack{1\\x:\overline{2}|}}$ to $A^{(2)}_{\substack{1\\45:\overline{2}|}}$. Make the same correction on the third and seventh lines of the answer.

[8/6/2017] On page 256, on the fifth line of Subsection 12.2.1, add "this" before "section".

[1/25/2018] On page 258, two lines above Example 12G, add "for" between "benefits" and "a coverage".

[1/23/2017] On page 285, 5 lines from the bottom of the page, replace the incomplete phrase "since there is a 40" with

since there is a 40% chance of surviving t years, so there is a 60% chance of not surviving that long. Then

[1/23/2017] On page 286, replace "highest 20" at the end of the second line to the answer to Example 13K with

highest 20% of its possible values. The 80th percentile of Z is then v^t. To compute t, we need to make $\Pr(20 \le T_{30} \le t) = 0.2$, or ${}_{20}p_{30} - {}_tp_{30} = 0.2$.

[1/23/2017] On page 290, in exercise 13.12, replace (i) with

principal and accumulated interest at 16% compounded annually at the end of 20 years if it does not default.

Replace the fourth line with

A risk-free investment will pay principal and accumulated interest at 10% compounded annually at the end of 20 years.

[1/23/2017] On page 295, in the solution to exercise 13.12, on the third line, the incomplete sentence "Just because the bonds pay 10" should be replaced with the following:

Just because the bonds pay 10% or 16% does not imply that we should use one of those as a valuation rate. The valuation rate doesn't matter!

[1/23/2017] On page 296, in the solution to exercise 13.17, replace the first two lines with

Z is highest when T_x is lowest. We want t such that the probability of living beyond t is 30%, or ${}_tp_x = 0.3$. For this beta distribution of mortality, ${}_tp_x = \left(\frac{40-t}{40}\right)^{0.3}$.

[1/23/2017] On page 297, in the solution to exercise 13.19, on the tenth line, replace "of time is 25" with

of time is 25%, or for which ${}_tp_{25} = 0.75$) correspond to the 75th percentile of the present value of the insurance.

[3/6/2017] On page 426, in the solution to exercise 19.19, on the fourth line, put an exponent 2 on the last term in the numerator:

$$= \frac{1 - 2\delta({}^2\bar{a}_{x:\overline{n}|}) - (1 - \delta\,\bar{a}_{x:\overline{n}|})^2}{\delta^2}$$

[8/14/2017] On page 429, in the solution to exercise 19.26, on the first two lines, replace T_x with K_x+1 four times.

[3/4/2017] On page 438, in the second paragraph of Section 20.2, on the fourth line, replace (14/5) with (14/6).

[1/25/2018] On page 496, 5 lines from the bottom of the page, change 45 to (45).

[1/3/2017] On page 540, in the answer to Example 26C, on the first line, delete "death".

[8/24/2017] On page 584, on the first line of the answer to Example 29B, change $\bar{A}^2_x$ to A^2_x (remove the bar).

[1/25/2018] On page 645, on the fourth line of Example 32C, change "age (50)" to "age 50".

[1/12/2017] On page 737, in the solution to exercise 37.27, the notation is sloppy. The following solution cleans up the notational errors:

The retrospective reserve for our policy is the same as for a standard whole life insurance of 1000. Using the insurance-ratio formula, that is

$$1000\,{}_{20}V_{40} = 1000\left(\frac{0.4-0.2}{1-0.2}\right) = 250$$

Prospectively, the net premium reserve for our special policy can be expressed as $2000A_{60} - P\ddot{a}_{60} = 800 - P\ddot{a}_{60}$. Let's calculate $\ddot{a}_{60}$. To do this, let's back out d.

$$\begin{aligned}
0.0095 &= \frac{dA_{40}}{1-A_{40}}\\
0.0095 &= \frac{0.2d}{0.8}\\
d &= \frac{0.0095(0.8)}{0.2} = 0.038\\
\ddot{a}_{60} &= \frac{1-A_{60}}{d} = \frac{1-0.4}{0.038} = 15.78947
\end{aligned}$$

Now we can back out P from the time-20 reserve.

$$\begin{aligned}
250 &= 800 - 15.78947P\\
P &= \frac{550}{15.78947} = \boxed{\mathbf{34.83}}
\end{aligned}$$

[1/10/2017] On page 757, on the last line of Example 39D, add "at time 14" between "future loss" and "increase".

[6/18/2017] On page 801, in the solution to exercise 39.60(c), on the first displayed line, change $\ddot{a}_{\overline{\omega-x}|}$ to $\ddot{a}_{\overline{20}|}$. On the second displayed line, change $\ddot{a}_{\overline{20}|}$ to $\ddot{a}_{\overline{\omega-x}|}$.

[9/7/2017] On page 806, on the first line (below Table 40.1), change $\alpha-\beta$ to $\beta-\alpha$.

[1/10/2017] On page 815, in the solution to exercise 40.16, on the last line of the page, change ${}_{20}q_{55}$ to ${}_{20}p_{55}$.

[2/26/2017] On page 843, in the solution to exercise 41.16, replace the last four lines with

$$\begin{aligned}
{}_{8.5}V &= \frac{(1122+175)_{8.25}V+P}{1.1^{0.25}} - \frac{10{,}000(0.010154/1.048809)}{1-0.010154} = 1208.88\\
{}_{8.7}V &= \frac{({}_{8.5}V+P)(1.1^{0.2}) - 10{,}000\,{}_{0.2}q_{78.5}/1.1^{0.3}}{1-{}_{0.2}q_{78.5}}\\
{}_{0.2}q_{78.5} &= 1-(1-0.04)^{0.2} = 0.008131\\
{}_{8.5}V &= \frac{(1122+175)_{8.5}V+P}{1.1^{0.2}} - \frac{10{,}000(0.008131)/1.0290006}{1-0.008131} = \boxed{\mathbf{1342.41}} \qquad \textbf{(E)}
\end{aligned}$$

[9/8/2017] On page 886, formula (44.6) should be

$$\int_0^t {}_sp_x^{\overline{00}}\mu_{x+s}^{01}\,\mathrm{d}s\,t$$

[10/15/2017] On page 908, replace the paragraph before equation (45.5) with

After replacing the left side of equation (**??**) with (*), multiply both sides of the resulting equation by h, and solve for ${}_{t-h}V^{(i)}$:

In equation (45.5), replace = with ≈.

[4/24/2017] On page 959, on the second line of Section 47.1, change "Markov chain" to "multiple decrement".

[9/24/2017] On page 973, in the solution to exercise 47.2, on the second and fourth lines, change ${}_1q^{()}x$ to $q_x^{(1)}$.

[2/26/2017] On page 1094, in the solution to exercise 54.2, on the third line, change ${}_tp_{xy}$ to ${}_tp_{\overline{xy}}$.

[3/5/2017] On page 1168, in exercise 58.45, on the first line, change 1ives to lives.

[9/27/2017] On page 1226, on the sixth line, change "should be" to "should we".

[10/8/2017] On page 1228, in the table near the bottom of the page, delete the Career Total column. Change the exponents in the column "Discount Factor" from 32, 33, 34, 35 to 22, 23, 24, 25 respectively.

[4/2/2017] On page'1233, in Example 61J, on the ninth line of the page, change "ending at the 62nd birthday" to "beginning at the 62nd birthday".

[9/15/2017] On page 1233, in the last displayed formula on the page, change $\left(\frac{1+1.03}{2}\right)$ to $\left(\frac{1/1.03+1}{2}\right)$.

[3/5/2017] On page 1298, in equation (65.4), the lower limit of the sum should be $j=0$ instead of $j=1$.

[3/5/2017] On page 1304, in equations (65.3) and (65.4), the lower limit of the sum should be $j=0$ instead of $j=1$.

[10/15/2017] On page 1361, in the solution to Quiz 67-2, change the final answer 0.168 to 0.0168.

[4/19/2017] On page 1457, in question 17(i), add "based on" after "is".

[4/23/2017] On page 1528, in question 7, in statement (iii), change "9.80, 10.50, 11.30, and 12.40" to "980, 1050, 1130, and 1240".

[4/23/2017] On page 1548, in question 6(c), change ${}_{10}p_{40}^{01}$ to ${}_{10}p_{35}^{01}$.

[4/19/2017] On page 1595, replace the solutions to questions 6(d) and 6(e) with the following:

(a) Salary increases 3% per year, and we account for that in the following formula:

$$3(100{,}000)\left(\frac{14}{1.05^{0.5}}+\frac{15(1.03)}{1.05^{1.5}}+\frac{15(1.03^2)}{1.05^{2.5}}\right)\Big/978=\boxed{\mathbf{12{,}917}}$$

(a) Salaries discounted to age 62 are

$$100{,}000\left(978+\frac{964(1.03)}{1.05}+\frac{879(1.03^2)}{1.05^2}\right)\Big/978=283{,}177$$

The percentage of salary needed to fund 12,917 is $100(12{,}917)/283{,}177=\boxed{\mathbf{4.5614}}$.

[7/27/2017] On page 1655, in the solution to question 2(c), on the second line from the end, change $Ep20_{45}$ to ${}_{20}E_{45}$.

[4/20/2017] On page 1658, in the solution to question 5(d), on the fourth line, replace the sentence starting with "Interest" with

Interest is $0.05(6321.6395+3500-175)=482.332$.

Replace the last sentence with

Profit is $6321.6395+3500-175+482.332-71.5855-10{,}105.27=\boxed{\mathbf{-47.884}}$.

[4/23/2017] On page 1683, replace the solution to question B7 with the following:

(a)

$$\frac{980}{A_{47}}=\frac{980}{0.21936}=4468$$
$$\frac{1050}{A_{48}}=\frac{1050}{0.22892}=4587$$

The rate in year 2 is $4468/100{,}000=\boxed{\mathbf{4.468\%}}$. The total face amount after the reversionary bonus is 104,468. The rate in year 3 is $4587/104{,}468=\boxed{\mathbf{4.391\%}}$.

(b) At time 3, original face amount is 100,000 and bonus amount is 4468, as computed in part (a). Let x be the rate on the original amount. The cost of the dividend is then $100{,}000xA_{48}+4468(2x)A_{48}$. Set this equal to 1050 and solve.

$$22{,}892x+4468(2)(0.22892)x=1050$$
$$x=\frac{1050}{24{,}937.63}=\boxed{\mathbf{4.211\%}}$$

(c) The reserve on the original face amount is

$$100{,}000\left(1-\frac{\ddot{a}_{48}}{\ddot{a}_{46}}\right)=100{,}000\left(1-\frac{13.6224}{13.9546}\right)=2380.58$$

The cumulative bonus, as computed in part (a), is $4468+4587=9055$; the split of the rate between the original face amount and the bonus in part (b) does not affect the total bonus. The reserve on the bonus is the single net premium, or $9055A_{48}=9055(0.22892)=2072.87$. Total reserve is $2380.58+2072.87=\boxed{\mathbf{4453.45}}$.

[4/23/2017] On page 1700, replace the solution to question B6 parts (c) and (d) with:

(c) Use formula (44.7)

$$ {}_{10}p_{35}^{01}=\int_0^{10} {}_tp_{35}^{00}\,\mu_{35+t}^{01}\,{}_{10-t}p_{35+t}^{11}\,\mathrm{d}t$$
$$ {}_tp_{35}^{00}=\exp\left(-\int_0^t\bigl(0.02u+0.005u\bigr)\mathrm{d}u\right)$$
$$=\exp\bigl(-0.0125t^2\bigr)$$

$$\begin{aligned}
{}_{10-t}p_{35+t}^{11} &= \exp\left(-\int_t^{10} 0.01\,u\,\mathrm{d}u\right)\\
&= \exp\bigl(-0.005(10^2-t^2)\bigr)\\
{}_{10}p_{35}^{01} &= \int_0^{10} 0.02\,t\,e^{-0.0125t^2-0.005(10^2)+0.005t^2}\,\mathrm{d}t\\
&= 0.02e^{-0.5}\int_0^{10} t\,e^{-0.012t^2}\,\mathrm{d}t\\
&= -\frac{0.02e^{-0.5}}{0.024}\,e^{-0.012t^2}\Big|_0^{10}\\
&= -\frac{0.02e^{-0.5}}{0.024}(e^{-1.2}-1) = \boxed{\mathbf{0.353206}}
\end{aligned}$$

(d) Let's calculate ${}_{10}p_{35}^{00}$, and then the probability of death, of being in state 2, is the complement of the probabilities of the other two states.

$$\begin{aligned}
{}_{10}p_{35}^{00} &= \exp\left(-\int_0^{10}(0.02t+0.005t)\mathrm{d}t\right)\\
&= e^{-0.0125(10^2)} = 0.286505
\end{aligned}$$

The probability of death in 10 years is $1-0.286505-0.353206=\boxed{\mathbf{0.360289}}$.

[4/23/2017] On page 1702, in the solution to question 19, on the second-to-last line, replace "the variance of the expected values" with "the expected value of the variances".

[2/27/2017] On page 1787, in the solution to question 5, change lines 2–6 to

$$\begin{aligned}
{}_{4|}q_{\overline{80:90}} &= {}_5q_{\overline{80:90}} - {}_4q_{\overline{80:90}} = {}_5q_{80}\,{}_5q_{90} - {}_4q_{80}\,{}_4q_{90}\\
{}_4q_{80} &= 1-\frac{l_{84}}{l_{80}} = 1-\frac{2{,}660{,}734}{3{,}914{,}365} = 0.320264\\
{}_5q_{80} &= 1-\frac{l_{85}}{l_{80}} = 1-\frac{2{,}358{,}246}{3{,}914{,}365} = 0.397541\\
{}_4q_{90} &= 1-\frac{l_{94}}{l_{90}} = 1-\frac{403{,}072}{1{,}058{,}491} = 0.619201\\
{}_5q_{90} &= 1-\frac{l_{95}}{l_{90}} = 1-\frac{297{,}981}{1{,}058{,}491} = 0.718485\\
{}_{4|}q_{\overline{80:90}} &= (0.397541)(0.718485)-(0.320264)(0.619201) = 0.087319
\end{aligned}$$

[7/20/2017] On page 1845, in the solution to question 14, on the fifth line, replace ${}_{0.5}q_{15.6}$ with ${}_{0.4}q_{15.6}$.

[7/27/2017] On page 1882, in the solution to question 3(c)(i), on the first line, change $P\,i_t$ to Π_t.

[3/27/2017] On page 1902, in the solution to question 11, on the first displayed line, the left side should be $P\,\ddot{a}_{30:\overline{5|}}$.

[3/4/2017] On page 1908, replace the solutions to questions 5(b), 5(c), and 5(e) with the following:

(b) [**Section 65.1**] The initial reserve for year 2 is 0. The probability of persisting to the end of the year based on profit testing assumptions is $1-0.018-0.10=0.882$.

$$2200(0.9)(1.06)-0.018(100{,}000)-0.882(98.23)=\boxed{\mathbf{212.16}}$$

(c) [**Section 65.2**]

$$\text{NPV} = -660 + \frac{115}{1.1} + \frac{212.16(0.82)}{1.1^2} + \frac{340(0.82)(0.882)}{1.1^3} = \boxed{\mathbf{-226.93}}$$

(e) [**Section 65.2**] Continuing the calculation in (d), for each unit increase in G, Pr_0 decreases by $0.3G$. Pr_2 increases by $0.9(1.06)G = 0.954G$, and Pr_3 increases by $1.06G$. The increase in NPV is

$$\left(-0.3 + \frac{0.5088}{1.1} + \frac{(0.82)(0.954)}{1.1^2} + \frac{(0.82)(0.882)(1.06)}{1.1^3}\right)G = 1.385042G$$

To increase the NPV from −226.93 to 100, the gross premium must increase by $326.93/1.385024 =$ 236.04, making the premium $\boxed{\mathbf{2436.04}}$.

[3/4/2017] On page 1909, replace the solutions to questions 6(b) and 6(c) with the following:

(b) [**Section 61.4**] For Tom, final salary in 2040 is $65{,}000(1.03^{24}) = 132{,}131.62$. Accruals for 2 years of service are $0.013(2) = 0.026$. Terminations are 0.06 in year 3, so 0.94 remain to retirement.

The initial liability for the retirement benefits is

$$0.94(9.6)(0.026)(132{,}131.62)/1.065^{25} = 6{,}421.54$$

The discounted value of the ending liability is 3/2 of this.

The initial liability for the termination benefits is

$$0.06(9.6)(0.026)(65{,}000)/1.065^{25} = 201.64$$

The discounted value of the ending liability is 3/2 of this.

The total liability is $6{,}421.54 + 201.64 = \boxed{\mathbf{6623.18}}$. The normal cost is 1/2 of this, or $\boxed{\mathbf{3311.59}}$.

For Ken, final salary in 2030 is $80{,}000(1.03^{14}) = 121{,}007.18$. Accruals for 5 years of service are $0.013(5) = 0.065$. There are no terminations. The initial liability is

$${}_0V = 9.6(0.065)(121{,}007.18)/1.065^{15} = 29{,}359.70$$

The normal contribution after $n = 5$ years of service is ${}_0V/n = \boxed{\mathbf{5{,}871.94}}$.

(c) [**Section 61.4**] Presumably Ken got his 3% salary increase. The liability at 1/1/17 for the benefit at age 65 is accrued one additional year over the liability computed in part (b), but with the same projected salary:

$$0.5(9.6)(0.078)(121{,}007.18)/1.065^{14} = 18{,}760.85$$

The initial liability for the normal benefit at age 62 is

$$0.5(10.3)(0.078)(80{,}000)(1.03^{11})(0.79)/1.065^{11} = 17{,}578.54$$

The initial liability for the bridge benefit is the 0.5 probability times 15 per month, or 180 per year, times 6 years of accrued service times $\ddot{a}^{(12)}_{62:\overline{3}|}$ discounted 11 years,

$$0.5(180)(6)(2.7)(0.79)/1.065^{11} = 576.15$$

The total actuarial liability is $18{,}760.85 + 17{,}578.54 + 576.15 = \boxed{\mathbf{36{,}015.54}}$. The liability one year later, discounted to the beginning of the year, only differs in that 7 years of service are used instead of 6, and there are no exit benefits in year 6, so the normal contribution is $36{,}015.54/6 =$ $\boxed{\mathbf{6{,}152.59}}$.