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

In practice exam 1 question B6, page 1432, note the change to the question.

In all exams, question B7 is wrong: either it is missing or it duplicates another question. Exams 4, 6, 8, 9, 12, and 13 have a seventh question in Section B; the others don't, so delete question B7 from exams 10 and 11. The following link has the correct questions B7 and solutions for those exams: `http://errata.aceyourexams.net/Question7.pdf`.

[8/28/2016] On page xvi, inthe table, change the entry for Fall 2015 Interest rate models from 20 to 10.

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

[2/10/2016] On page 96, in exercise 5.34(ii), change two ts to xs, so that it reads

$$S_0(x) = 1 - \frac{x}{\omega}, \qquad 0 \le x \le \omega$$

[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 $v = \left(\frac{60-t}{50}\right)$." with "where $u = \left(\frac{60-t}{50}\right)$ and $\mathrm{d}v = e^{-0.01t}\,\mathrm{d}t$."

[2/9/2016] On page 189, in Table 10.1, on the line for Deferred term insurance, second column, first row, change $K_x \le n$ to $K_x < n$.

[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.

[2/6/2016] On page 349, in Table 17.2, on the row for "Deferred temporary life annuity" in the second column, on the last line of the box, change $K_x \geq \min(n+m, K_x+1)$ to $k \geq \min(n+m, K_x+1)$.

[6/14/2016] On page 352, in Section 17.2, on the line below the timeline, change "annuity-due" to "annuity-immediate".

[2/29/2016] On page 371, in the solution to exercise 17.1(b)(ii), on the first line, change the first summation subscript $n-1$ to $n=1$.

[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:

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

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

[4/25/2016] On page 443, in exercise 20.4(i), change $0 \leq 0 \leq 105$ to $0 \leq x \leq 105$

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

[8/28/2016] On page 702, in exercise 36.6, change the last line to

Calculate the net premium reserve at the beginning of year 2, after the premium has been paid.

[3/11/2016] On page 711, in the solution to exercise 36.13, on the third displayed line, $a_{x:\overline{10}|}$ should be $\ddot{a}_{x:\overline{10}|}$.

[1/12/2017] On page 735, 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”.

[10/18/2016] On page 800, in the solution to exercise 39.63, on the second line, change $+d$ to $-d$.

[1/10/2017] On page 813, in the solution to exercise 40.15, on the first line, change 2–10 to 2–20. On the eighth line, change ${}_{20}q_{55}$ to ${}_{20}p_{55}$.

[7/13/2016] On page 835, in exercise 41.38, on the first line, change “insurance of 1” to “insurance of 1000”.

[2/26/2017] On page 841, in the solution to exercise 41.16, replace the last four lines with

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

[6/27/2016] On page 905, on the third displayed line of the answer to Example 45G, change the first subscript to $x+5$. Change $\bar{a}^{12}_{x+t}$ to $\bar{a}^{11}_{x+t}$. After these two changes, the line will read

$${}_5V^{(1)} = 10{,}000\bar{A}^{12}_{x+5} + 1000\bar{a}^{11}_{x+5} = \frac{10{,}000}{3} + \frac{100{,}000}{9} = \boxed{\mathbf{14{,}444.44}}$$

[4/24/2017] On page 957, on the second line of Section 47.1, change “Markov chain” to “multiple decrement”.

[7/19/2016] On page 979, in the solution to exercise 47.28, on the second line, change ${}_{40}p^{(\tau)}_{40}$ to ${}_{20}p^{(\tau)}_{40}$.

[10/6/2016] On page 1062, in the solution to exercise 52.4, on the third displayed line of the page, change ${}_{30|}q^{(W)}_{40}$ to ${}_{30|10}q^{(W)}_{40}$.

[2/26/2017] On page 1092, in the solution to exercise 54.2, on the third line, change ${}_tp_{xy}$ to ${}_tp_{\overline{xy}}$.

[7/29/2016] On page 1111, in the solution to exercise 55.13, on the second displayed line, change $\mathring{e}_{65:65}$ to $\mathring{e}_{65:55}$.

[3/22/2016] On page 1142, in the solution to exercise 57.5, on the third-to-last line, change $0.05\big/\big(0.005+2(0.03)\big)$ to $0.005\big/\big(0.005+2(0.03)\big)$

[3/5/2017] On page 1166, in exercise 58.45, on the first line, change 8ill to Bill and 1ives to lives.

[9/12/2016] On page 1182, in the solution to exercise 58.46(a)(ii), a v^t is missing. The correct solution is

$$\int_0^\infty v^t\,{}_tp_x\,{}_tp_y\,\mu_{y+t}\,\mathrm{d}t$$

[8/28/2016] On page 1225, in the table, change the retirement probability for age 62 from 0.02892 to 0.02692.

[5/2/2016] On page 1226, on the third line of the answer to Example 61G, change “57 and 58” to “58 and 59”.

[1/5/2016] On page 1227, on the third line, change “normal contribution” to “accrued liability”.

[4/15/2016] On page 1227, two lines above the third displayed line (the one starting $C=$), change 0.98830 to 0.99830.

[3/29/2016] On page 1229, replace the top of the page, up to the end of the answer to Example 61I, with the following:

The accrued liability at age 62 under TUC is

$$\begin{aligned}
{}_{32}V &= 0.018(32)\left(\frac{200{,}000}{1.03}\right)\left(0.7\frac{r_{62}}{l_{62}^{(\tau)}}(10.2309)+0.8\frac{r_{63}}{l_{62}^{(\tau)}}(9.4209)+0.9\frac{r_{64}}{l_{62}^{(\tau)}}(8.6666)+\frac{r_{65}}{l_{62}^{(\tau)}}\left(\frac{9.8969}{1.06^3}\right)\right)\\
&= 111{,}845\left(\frac{0.7(2692)(10.2309)+0.8(1350)(9.4209)+0.9(2006)(8.6666)+(11{,}246)(8.3096)}{18{,}106}\right)\\
&= 855{,}854
\end{aligned}$$

The accrued liability at age 63 under TUC, discounted to age 62, is

$$\begin{aligned}
\frac{l_{63}^{(\tau)}}{l_{62}^{(\tau)}}v\,{}_{33}V &= 0.018(33)(200{,}000)\left(0.8\frac{r_{63}}{l_{62}^{(\tau)}}(9.4209)+0.9\frac{r_{64}}{l_{62}^{(\tau)}}(8.6666)+\frac{r_{65}}{l_{62}^{(\tau)}}\left(\frac{9.8969}{1.06^3}\right)\right)\\
&= 118{,}800\left(\frac{0.8(1350)(9.4209)+0.9(2006)(8.6666)+11{,}246(8.3096)}{18{,}106}\right)\\
&= 782{,}580
\end{aligned}$$

The EPV of the benefits paid during the year takes into account one-half of a year accrual. It is based on a final salary of half the age-61 salary and half the age-62 salary. It is

$$(200{,}000)\left(\frac{1+1/1.03}{2}\right)(0.018)(32.5)(0.7)(10.2309)\frac{2692}{18{,}106} = 122{,}767$$

So the normal contribution is $782{,}580+122{,}767-855{,}854 = \boxed{\mathbf{49{,}493}}$.

[4/15/2016] On page 1238, in exercise 61.23(iii), delete the word "present".

[1/18/2016] On page 1239, on the first line of the page, change "61.26 and 61.27" to "61.26 through 61.28".

[9/23/2016] On page 1246, in the solution to exercise 61.25, on the second line, change 47,500 to 47,300. Change the seventh and eighth lines to

The probability of withdrawal is 0.04. The EPV of benefits paid to withdrawers is

$$\frac{(0.04)(0.23125)(91{,}100)(4.9832)}{1.06^{0.5}} = \boxed{\mathbf{4{,}100.67}}$$

[2/9/2016] On page 1246, replace the last line of the solution to exercise 61.28 with

The probability of staying in the plan to the end of the year is $(1000-80-10)/1000 = 0.91$. The expected present value of the end-of-year actuarial liability is $392{,}000(0.91/1.05) = 339{,}733.33$. The normal contribution is $339{,}733.33+29{,}682.20-359{,}278.69 = \boxed{\mathbf{10{,}136.84}}$.

[3/5/2017] On page 1292, in equations (65.3) and (65.4), the lower limit of the sum should be $j=0$ instead of $j=1$.

[2/15/2016] On page 1293, Example 65B assumes that the full 30% first year expense is considered precontract expense. This assumption is inconsistent with the assumptions used in Example 65A. Here is a version of the example using the assumption that only the excess over the renewal expense is considered precontract:

In the 5-year term example, you have determined that with a premium of 2200, the NPV at 10% is 165.52.

You would like to adjust the premium so that the profit margin is 3%.

You are given that at 10%, $a_{[50]:\overline{5}|}^{(\tau)} = 2.72267$ and $\ddot{a}_{[50]:\overline{5}|}^{(\tau)} = 3.39504$.

Determine the premium needed.

ANSWER: Let G be the premium needed. Then the present value of premiums is $G\ddot{a}_{x:\overline{5}|} = 3.39504G$.

Calculating the effect of one unit of premium on the NPV is more complicated. Each unit of premium is accumulated to the end of the year at the *assumed rate* of 6% as part of the profit calculation, and then discounted from the end of the year to issue at the NPV rate as part of the NPV calculation. You see what's happening? You lose profit because you accumulate at 6% but discount at 10%. Percent-of-premium expenses are treated the same way, and since expenses decrease profit, reducing them increases profit. However, *precontract expenses are not accumulated and discounted*, so they are not reduced and profit is not increased. By isolating the precontract expenses the NPV is lower than it would otherwise be.

In the term insurance example, annual expenses are 5% and precontract expenses are 25%. After expenses and discounting with interest to the beginning of the year, one unit of premium causes the following changes to the profits in years 0–5:

Year	0	1	2	3	4	5
Increase in profit	−0.25	$\frac{1.06(0.95)}{1.1}$	$\frac{1.06(0.95)}{1.1}$	$\frac{1.06(0.95)}{1.1}$	$\frac{1.06(0.95)}{1.1}$	$\frac{1.06(0.95)}{1.1}$

The present value of the sum of these is

$$\frac{1.06(0.95)}{1.1}\ddot{a}_{x:\overline{5}|} - 0.25 = 2.858005$$

Now let's solve for a 3% profit margin. For a 3% profit margin, we need

$$165.52 + 2.858005(G - 2200) = 0.03(3.39504G)$$

Let's solve for G.

$$\begin{aligned} 165.52 + 2.858005G - 5716.01 &= 0.101851G \\ 2.756154G &= 6122.091 \\ G &= \boxed{\mathbf{2221.24}} \end{aligned}$$

□

[3/5/2017] On page 1298, in equations (65.3) and (65.4), the lower limit of the sum should be $j = 0$ instead of $j = 1$.

[9/23/2016] On page 1310, in the solution to exercise 65.17, on the third through fifth lines, every subscript 50 should be replaced with subscript $50 + t$, so they look like this:

$$\begin{aligned} \sum_{k=0}^{\infty} v^{k+1}\,{}_kp_{50+t}\big(10{,}000q_{50+t+k} + 10{,}000(0.001)\big) &= 10{,}000(A_{50+t} + 0.001v\ddot{a}_{50+t}) \\ &= 10{,}000A_{50+t} + 10v\left(\frac{1 - A_{50+t}}{d}\right) = 250 + 9750A_{50+t} \end{aligned}$$

where we've used that at $i = 0.04$, $v/d = (1/1.04)(1.04/0.04) = 25$, as well as $\ddot{a}_{50+t} = (1 - A_{50+t})/d$. Thus the

[4/8/2016] On page 1316, on the first displayed line, change 1399.19 to 1390.19.

[9/21/2016] On page 1321, in the solution to exercise 66.3, on the displayed line, change ${}_{10}E_{64}$ to ${}_{10}E_{54}$.

[10/21/2016] On page 1340, in exercise 67.9(i), add "at time 10" between "value" and "is".

[9/14/2016] On page 1366, in the solution to exercise 68.2, on the fourth line, change "the actual profit was 5" to "the actual profit was −5."

[12/21/2015] On page 1369, on the last line, change "Uninsured" to "Uninsurable".

[1/16/2016] On pages 1396–1397, in the solution to exercise 70.5, replace the last line of page 1396 and the first three lines on page 1397 with

$$\begin{aligned}\mathbf{E}[YZ \mid T_{45} > 20] &= 1164.676\,\mathbf{E}[Z \mid T_{45} > 20] = 1164.676e^{-20\delta}(1000\bar{A}_{65})\\ \mathbf{E}[YZ] &= 1164.676e^{-20\mu}e^{-20\delta}(1000\bar{A}_{65})\\ &= 1164.67\,{}_{20}E_{45}(1000\bar{A}_{65})\\ &= 1164.67\,\mathbf{E}[Z]\\ &= (1164.676)(50.4741) = 58{,}786\end{aligned}$$

[3/23/2016] On page 1397, in the solution to exercise 70.6, on the first line, replace ${}_2q'^{(2)}_{60}$ with ${}_2q'^{(1)}_{60}$. On the last line, replace 0.89442 with 0.89443.

[10/6/2016] On page 1410, in the solution to exercise 70.46, change the upper right entry of the matrix from 0 to p_{03}. It is also not true that $p_{13} = p_{02}$ since the probability of (x) dying in a year is $p_{02} + p_{03}$; similarly $p_{23} \neq p_{01}$. All three statements are false.

[3/9/2016] On page 1432, in question 6, change the first bullet to

At retirement at age 65, the plan pays a monthly whole life annuity-due providing annual income that accrues at the rate of 1.5% of final salary up to 100,000 and 2% of the excess of final salary over 100,000 for each year of service.

[8/28/2016] On page 1442, in question 6(a), on the second line, change 400,000 to 399,000.

[4/19/2017] On page 1447, in question 17(i), add "based on" after "is".

[8/26/2016] On page 1453, in question 6(c), on the first line, change 109,700 to 100,300.

[4/23/2017] On page 1540, in question 6(c), change ${}_{10}p^{01}_{40}$ to ${}_{10}p^{01}_{35}$.

[4/5/2016] On page 1561, in question 4(iv), delete "for at most 10 years". In part (c) of the question, change v^k to $v^{0.25k}$.

[4/19/2017] On page 1587, 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:

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

(a) Salaries discounted to age 62 are

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

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

[3/29/2016] On pages 1599-1600, replace the solution to question 6 parts (c)–(e) with the following:

(c) The projected final average salary is $100{,}000(1.04^{17}+1.04^{18}+1.04^{19})/3=202{,}686$. Multiply this by the accrued percentage, $0.015(10)=0.15$, and by $\ddot{a}_{65}$:

$$202{,}686(0.15)(10.650)=323{,}790$$

Discount this with interest and mortality to age 45.

$$\frac{323{,}790}{(1+i)^{20}}\left(\frac{l_{65}}{l_{45}}\right)=\frac{323{,}790}{1.05^{20}}\left(\frac{7{,}533{,}964}{9{,}146{,}051}\right)=\boxed{\mathbf{100{,}326}}$$

(c) For PUC with no exit benefits, the normal contribution is the proportion of the actuarial liability for 1 year. Here the actuarial liability is based on 10 years. One year is 1/10 of 10 years, so the normal contribution is $\boxed{\mathbf{10{,}032.6}}$.

(c) For each unit of salary, the accumulated amount at age 65 is

$$1.05^{19}\sum_{j=1}^{20}\frac{1.04^{j-1}}{1.05^{j-1}}=1.05^{19}\left(\frac{1-(1.04/1.05)^{20}}{1-1.04/1.05}\right)=46.21746$$

For 100,000 salary, the accumulation is 4,621,746.

The final salary is $100{,}000(1.04^{19})=210{,}685$. We want k such that

$$\begin{aligned}100{,}326(1.05^{20})+4{,}621{,}746k&=0.5(210{,}685)(10.65)\\266{,}194.9+4{,}621{,}746k&=1{,}121{,}897\end{aligned}$$

Solving for k, we get $\boxed{\mathbf{0.18515}}$.

[3/21/2016] On page 1611, delete part (c) of the solution to question 4.

[10/21/2016] On page 1633, in the solution to question B1(c), change the final answer 5,213.21 to 5,110.99.

[4/17/2016] On page 1633, replace the solution to question 2 with

(a) The direct way to do this is to integrate t times the density function for the husband's survival, which is ${}_tp_x^{00}\mu^{02}+{}_tp_x^{01}\mu^{13}$, since the husband may die either by going from state 0 to state 2 or from state 1 to state 3. In carrying out the integrations, we will use $\int_0^\infty te^{-ct}\,dt=1/c^2$.

$$\int_0^\infty t\,{}_tp_x^{00}\mu^{02}\,dt=\int_0^\infty 0.03te^{-0.05t}\,dt=\frac{0.03}{0.05^2}=12$$

$$\begin{aligned}\int_0^\infty {}_tp_x^{00}\mu^{01}\int_0^\infty(t+u)\,{}_up_{x+t}^{11}\mu^{13}\,du\,dt&=\int_0^\infty 0.02e^{-0.05t}\int_0^\infty(t+u)(0.04)e^{-0.04u}\,du\,dt\\&=\int_0^\infty 0.02e^{-0.05t}\left(\frac{1}{0.04}+t\right)dt\\&=\frac{1}{2(0.05)}+\frac{0.02}{0.05^2}=10+8=18\end{aligned}$$

Expected survival time is $12+18=\boxed{\mathbf{30}}$.

However, a faster way to get the answer is to calculate expected time in state 0 and state 1, which in each case is the reciprocal of the constant force of transition out of the state. Expected time in state 0 is $1/0.05 = 20$. Expected time in state 1 is $1/0.04 = 25$. The probability of going to state 1, given that one exits state 0, is $0.02/0.05 = 0.4$. This is because the forces of transition out of state 0 are 0.02 and 0.03. The probabilities of going to the two states coming out of state 0 are proportional to the forces of transition to those states.

So life expectancy for the husband, amount of time in states 0 and 1, is $20+0.4(25) = \boxed{\mathbf{30}}$.

(b) The direct way is similar to (a), except we replace the integral for going from state 0 to state 2 with a double integral for going from state 0 to state 3 via state 2. This is similar to the double integral we did in part (a), except 0.02 and 0.04 are both replaced with 0.03, so the last two lines become

$$\int_0^\infty 0.03e^{-0.05t}\left(\frac{1}{0.03}+t\right)\mathrm{d}t = \frac{1}{0.04}+\frac{0.03}{0.05^2} = 20+12 = 32$$

Adding this to the integral for going from state 0 to state 3 via state 1, which is 18, we get $18+32 = \boxed{\mathbf{50}}$.

For the faster way, the expected amount of time in state 2 is $1/0.03 = 33\frac{1}{3}$, and the probability of going from state 0 to state 2 is $0.03/0.05 = 0.6$, so the expected amount of time in state 2 for one in state 0 is $0.6(33\frac{1}{3}) = 20$. Total expected time in states 0, 1, and 2 is $20+0.4(25)+0.6(33\frac{1}{3}) = \boxed{\mathbf{50}}$.

[10/26/2016] On page 1673, in the solution to question B2(d), on the last line, change $\left(1-\left(\frac{18}{20}\right)\right)^{0.5}$ to $\left(1-\left(\frac{18}{20}\right)^{0.5}\right)$.

[10/26/2016] On page 1676, replace the solution to question B6(c) with the following:

The net premium would be lower but is not payable once the system is in state 1. The net premium reserve is the expected present value of future benefits, and in state 1 this is unchanged, so the net premium reserve would be the same.

[4/23/2017] On page 1695, 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".

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

(c) Use formula (44.7)

$$\begin{aligned}
{}_{10}p_{35}^{01} &= \int_0^{10} {}_tp_{35}^{00}\,\mu_{35+t}^{01}\,{}_{10-t}p_{35+t}^{11}\,\mathrm{d}t \\
{}_tp_{35}^{00} &= \exp\left(-\int_0^t \bigl(0.02u+0.005u\bigr)\mathrm{d}u\right) \\
&= \exp\bigl(-0.0125t^2\bigr) \\
{}_{10-t}p_{35+t}^{11} &= \exp\left(-\int_t^{10} 0.01u\,\mathrm{d}u\right) \\
&= \exp\bigl(-0.005(10^2-t^2)\bigr) \\
{}_{10}p_{35}^{01} &= \int_0^{10} 0.02t\,e^{-0.0125t^2-0.005(10^2)+0.005t^2}\,\mathrm{d}t \\
&= 0.02e^{-0.5}\int_0^{10} t\,e^{-0.012t^2}\,\mathrm{d}t \\
&= -\frac{0.02e^{-0.5}}{0.024}\,e^{-0.012t^2}\Big|_0^{10}
\end{aligned}$$

$$= -\frac{0.02e^{-0.5}}{0.024}(e^{-1.2}-1) = \boxed{\mathbf{0.353206}}$$

(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 $1-0.286505-0.353206 = \boxed{\mathbf{0.360289}}$.

[10/26/2016] On page 1710, in the solution to question B4(a), on the last line, change 266.0965 to 265.3224.

[4/5/2016] On page 1721, in the solution to question B4(a), on the second to last line, on the right side, replace $G(0.03\ddot{a}_{40:\overline{30}|}+0.27)$ with $4G(0.03\ddot{a}_{40:\overline{30}|}+0.27)$. On the last line, change 15.35302 to 15.35306.

[10/26/2016] On page 1721, in the solution to question B4(b), additional precision is needed on the second-to-last line, or else the answers to (b) and (c) are the same. Change 13.5873 on that line and on the last line to 13.58728, and change the final answer to 15.35257. In (c), change the final answer to 15.35254.

[10/26/2016] On page 1722, in the solution to question B6(c), two lines from the end, change 0.28324 to 0.28422. On the last line, change the final answer from 283.24 to 284.22. In part (d), on the last line, change 283.24 to 284.22 and change −3.8164 to −2.8327.

[9/24/2016] On page 1725, in the solution to question 37, on the line for age 30 in the table, exchange 8,950,901 and 9,501,381.

[2/27/2017] On page 1779, in the solution to question 5, change lines 2–6 to

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

On the third line from the end, change ${}_4A_{\overline{80:90}} - {}_5A_{\overline{80:90}}$ to ${}_5A_{\overline{80:90}} - {}_4A_{\overline{80:90}}$

[3/29/2016] On page 1796, in the solution to question 11, on the first line, change $Y = \mathrm{Var}(1.06Z)$ to $Y = 1.06Z$.

[5/1/2016] On page 1841, in the solution to question 3(c), replace the first line with

$${}_sq_{xy} = 1 - {}_sp_x\,{}_sp_y$$

[8/28/2016] On page 1869, in the solution to question 16, replace the last two lines with

$$\begin{aligned}\frac{({}_9V+P)(1+i)-q_{64}(10P)}{1-q_{64}} &= {}_{10}V = 9896.9\\ {}_9V = \frac{9896.9(1-0.01952)+(0.01952)(10)(693.7643)}{1.06} &- 693.7643 = \boxed{\mathbf{8588.44}} \qquad \textbf{(D)}\end{aligned}$$