Errata and Updates for ASM Exam LTAM (First Edition Second Printing) Sorted by Page

Practice Exam 7:A8, 10:A7, 12:A17, and 12:A18 are defective in that none of the answer choices is correct. See correction to Practice Exam 3:B6 below (page 1538). In Practice Exam 12, make the correction to WA question 2(b)(ii) indicated below, page 1628.

[9/4/2018] On page xix, in the caption of the table, change "MLC" to "LTAM".

[8/8/2018] On page 71, delete the "(5.11)" on the tenth line.

[9/21/2019] On page 100, in exercise 6.36, change $0 \le x \le \omega$ to $0 \le t \le \omega$.

[10/4/2018] On page 143, in the solution to exercise 8.5, on the second to last line, change 0.08080 to 0.13374. On the last line, change 88,08080 to 88.13374 and change 43.08080 to 42.63374.

[5/24/2019] On page 169, in the solution to exercise 9.17, on the first line, change l_{80} to $l_{[80]}$.

[10/16/2018] On page 189, on the last line of the answer to Example 10H, change ${}_3p_{70}$ to ${}_3p_{77}$.

[7/30/2018] On page 195, in the solution to exercise 10.2, replace the solution, starting with the fourth line, with

$$ {}_{0.5}p(79.5,2024) = 1 - \frac{0.5q(79,2024)}{1-0.5q(79,2024)} = 1 - \frac{0.5(0.025203)}{1-0.5(0.025203)} = 0.987238 $$

The person turned 80 in 2025, so age 80 mortality is projected for 13 years.

$$ q(80,2025) = 0.032658(1-0.01)^{13} = 0.028658 $$

Half-year survivorship for (80) is

$$ {}_{0.5}p(80,2025) = 1 - 0.5(0.028658) = 0.985671 $$

The probability that the person dies during calendar year 2025 is $1-(0.987238)(0.985671) = \boxed{\mathbf{0.026908}}$.

[9/29/2018] On page 198, in the solution to exercise 10.10, on the second line, replace both 0.12s with 0.07s.

[8/12/2018] On page 198, in the solution to exercise 10.13, on the last line, change 0.062431 to 0.00057305 and change 0.24986 to 0.023938.

[8/9/2019] On page 199, in the solution to exercise 10.17, on the second line, change $0.01Z^{(2)}_{2017}$ to $0.05Z^{(2)}_{2017}$.

[4/22/2019] On page 199, in the solution to exercise 10.17, on the third line from the end, change $l\,m(80,2017)$ to $l\,q(80,2017)$.

[3/19/2019] On page 212, in equations (12.1) and (12.2), change b_k to b_{k+1} twice in each equation.

[8/8/2018] On page 215, 6 lines from the bottom, change $1.06^2 - 1 = 0.1236$ to $1.05^2 - 1 = 0.1025$.

[10/1/2019] On page 247, in the solution to exercise 12.47, on the fifth line, change the denominator 0.996 to 0.988.

[10/15/2019] On page 324, in Example 16B(iii), change t% to 5%.

[10/15/2019] On page 354, in the answer to Example 17A, on the second line change q_{47} to q_{67}. On the third line change q_{48} to q_{68}.

[7/23/2018] On page 359, in the solution to exercise 17.3, on the second line, change 1.05^{12} to $1.05^{1/12}$. Note, however, that it is unnecessary to calculate $i^{(12)}$; the tables give $i/i^{(12)} = 1.02271$, so you just have to multiply 0.18931 by 1.02271 to get the answer.

[10/17/2019] On page 376, on the seventh line of the answer to Example 19D, change ${}_{20}E_{85}$ to ${}_{20}E_{65}$.

[10/22/2019] On page 425, on the second line of the second paragraph, change equation (20.2) to equation (20.1).

[10/31/2019] On page 492, two lines above Example 24A, delete the words "used to".

[8/25/2018] On page 524, in exercise 26.14(ii), change $i=0.06$ to $i=0.05$.

[8/25/2018] On page 559, in the solution to exercise 27.27, change the last line to

$$G=\frac{6{,}830}{8.0192-1}=\boxed{\mathbf{973.05}}$$

[11/3/2019] On page 562, in Example 28C, add

(v) Deaths are uniformly distributed between integral ages.

The values for $\alpha(4)$ and $\beta(4)$ in the solution were taken from the old exam tables; current tables give those functions at 5%.

[7/27/2018] On page 645, on the last line of the answer to Example 33E, change 98,576.4 to 100,000 and change 0.08564 to 0.09866.

[8/31/2018] On page 655, in the solution to exercise 33.3, on the fifth displayed line on the page, change the denominator 0.04/1.04 to 0.039211. Change the last displayed line of the solution to

$$1000e^{-0.04(31)}-16.4074\left(\frac{1-e^{-0.04(32)}}{0.039211}\right)=-12.7163$$

[8/31/2018] On page 655, in the solution to exercise 33.4, on the first displayed line, delete $\ddot{a}_{65:\overline{20}|}=$. The line should read

$$P=\frac{A_{65:\overline{20}|}}{\ddot{a}_{65:\overline{20}|}}=\frac{0.43371}{11.8920}=0.036471$$

[8/31/2018] On page 711, replace the solution to exercise 37.3 with

Let's calculate the gross premium.

$$G(0.95\ddot{a}_{65}-0.95)=1000A_{65}+1000\,{}_{20}E_{65}\,A_{85}$$
$$G=\frac{354.77+0.24381(676.22)}{0.95(13.5498)-0.95}=43.5854$$

Now we calculate the EPV of benefits and expenses at time 30.

$$2000A_{95}+0.05G\,\ddot{a}_{95}=2(818.97)+0.05(43.5854)(3.8017)=1646.22$$

The gross premium reserve is $1646.22-43.5854(3.8017)=\boxed{\mathbf{1480.53}}$.

[11/18/2019] On page 751, in the solution to Quiz 39-1, on the second line, change ${}_tq_x$ to ${}_{k|}q_x$.

[11/22/2019] On page 757, on the fourth line, change "time t" to "time k".

[4/2/2019] On page 757, in Example 40F, on the third line, change "6% interest" to "5% interest".

[8/29/2019] On page 765, in the box for questions 40.10 through 40.13, on the last line, put a double-dot over $a_{85:\overline{3}|}$: $\ddot{a}_{85:\overline{3}|}=2.721091$.

[9/4/2018] On page 818, one line above Example 42C, change "is is" to "it is".

[8/31/2018] On page 831, in the solution to exercise 42.15, on the third line, change 0.00061728 to 0.00061690. Make the same change in the denominator of the fourth line, and in the numerator, change 6.1728 to 6.1690.

[9/4/2018] On page 848, on the fourth line of the Disability income paragraph, change "atate" to "state".

EXAMPLE 46F Using the Sickness-Death Model at $i = 0.05$, calculate the expected present value of a temporary 10-year continuous annuity paying 1 per year while in state 0 for someone age 55 currently in state 0.

[10/22/2019] On page 859, in the solution to exercise 44.9, on the last line, change ${}_2p^{11}_{[x]+2}$ to ${}_2p^{11}_{[x]+1}$.

[4/4/2019] On page 886, replace Example 46F and its solution with:

ANSWER: We start with a whole life annuity and subtract a 10-year deferred whole life annuity. After 10 years the person may be in state 0 or state 1, and we must consider the EPVs of annuities on individuals age 65 in either state.

$$\begin{aligned}
{}_{10|}\bar{a}^{00}_{55} &= v^{10}\left({}_{10}p^{00}_{55}\,\bar{a}^{00}_{65} + {}_{10}p^{01}_{55}\,\bar{a}^{10}_{65}\right)\\
&= \frac{(0.74091)(6.6338) + (0.11682)(0.0395)}{1.05^{10}} = 3.0202\\
\bar{a}^{00}_{55:\overline{10}|} &= 10.1228 - 3.0202 = \boxed{\mathbf{7.1026}}
\end{aligned}$$

[4/7/2019] On page 890, on the third displayed line, $(1+i)^h$ is missing from the left side. Change the line to

$${}_tV^{(1)}(1+i)^h = {}_hp^{11}_{x+t}\left(hB^{(1)}_{t+h} + {}_{t+h}V^{(1)}\right)$$

[7/31/2018] On page 891, on the last line of the page, change 22,560.41 to 21,440.15.

[9/10/2019] On pages 904–905, replace the somewhat confusing solution to exercise 46.6 with the following:

Ignoring death, the transition probability matrix for the states low risk, medium risk, and high risk, in that order, is

$$\begin{pmatrix} 0.6 & 0.4 & 0 \\ 0.2 & 0.5 & 0.3 \\ 0 & 0.2 & 0.8 \end{pmatrix}$$

The probability of death is 0.05. Making death the fourth state, we multiply our 3×3 matrix by 0.95 and put 0.05 in the fourth column to represent the probability of transition to the death state to obtain the following transition probability matrix:

$$\begin{pmatrix} 0.57 & 0.38 & 0 & 0.05 \\ 0.19 & 0.475 & 0.285 & 0.05 \\ 0 & 0.19 & 0.76 & 0.05 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

With this transition matrix, we can compute the state vector for each year. At the beginning of the first year, the system is in state 1. At the beginning of the second year, the state vector is $\begin{pmatrix} 0.57 & 0.38 & 0 & 0.05 \end{pmatrix}$. At the beginning of the third year, the state vector is

$$\begin{pmatrix} 0.57 & 0.38 & 0 & 0.05 \end{pmatrix}\begin{pmatrix} 0.57 & 0.38 & 0 & 0.05 \\ 0.19 & 0.475 & 0.285 & 0.05 \\ 0 & 0.19 & 0.76 & 0.05 \\ 0 & 0 & 0 & 1 \end{pmatrix} = \begin{pmatrix} 0.3971 & 0.3971 & 0.1083 & 0.0975 \end{pmatrix}$$

Now we compute expected present value of losses. In each year, we multiply the probability of each start-of-year state by 0.95, since only survivors result in paid losses, and by 100, 300, or 1000 for states

1, 2, 3 respectively, and discount for the number of years at 6%. In year 1, we get $100(0.95)/1.06 = 89.62$. In year 2, we get

$$\frac{\bigl(0.57(100)+0.38(300)\bigr)(0.95)}{1.06^2} = 144.58$$

In year 3, we get

$$\frac{\bigl(0.3971(100)+0.3971(300)+0.1083(1000)\bigr)(0.95)}{1.06^3} = 213.08$$

The expected present value of losses over a three year period is $89.62+144.58+313.08 = \boxed{\mathbf{447.28}}$.

[9/4/2018] On pages 911-912, in the solution to Quiz 46-2, on the first line, change $\bar{a}_{65}^{02}$ to $200\bar{a}_{65}^{02}$. Change the last line of the solution to

$$5000(0.53559) + \frac{2000}{1.05^{0.5}}(0.53559) + 200(10.9770) = \boxed{\mathbf{5918.72}}$$

[9/20/2018] On page 915, in expression (47.3), change $\bar{a}^{\overline{11}}_{x+t:\overline{n-(x+t)}|}$ to $\bar{a}^{\overline{11}}_{x+t:\overline{n-t}|}$.

[9/4/2018] On page 918, in the answer to Example 47B, change the last 3 lines of the page to

$$\begin{aligned}
\frac{\mathrm{d}\,{}_tV^{(1)}}{\mathrm{d}t} &= \delta\,{}_{10}V^{(1)} - \mu^{10}_{x+10}({}_{10}V^{(0)} - {}_{10}V^{(1)}) - \mu^{12}_{x+10}({}_{10}V^{(2)} - {}_{10}V^{(1)})\\
&\quad - \mu^{13}_{x+10}({}_{10}V^{(3)} - {}_{10}V^{(1)}) - \mu^{14}_{x+10}(-{}_{10}V^{(1)})\\
&= (0.05)(45{,}000) - 0.06(20{,}000-45{,}000) - 0.14(150{,}000-45{,}000)\\
&\quad - 0.08(400{,}000-45{,}000) - 0.02(-45{,}000)\\
&= \boxed{\mathbf{-38{,}450}}
\end{aligned}$$

[9/4/2018] On page 919, in the answer to Example 47C, change the third line to

Once someone enters states 3 or 4, it is impossible to get to state 2, so $\bar{A}^{32}_x = \bar{A}^{42}_x = 0$.

Change the first two displayed lines to:

$$\begin{aligned}
\frac{\mathrm{d}\bar{A}^{02}_{x+t}}{\mathrm{d}t} &= \delta\bar{A}^{02}_{x+t} - \mu^{01}_{x+t}(\bar{A}^{12}_{x+t} - \bar{A}^{02}_{x+t}) - \mu^{02}_{x+t}(1-\bar{A}^{02}_{x+t}) - (\mu^{03}_{x+t} + \mu^{04}_{x+t})(-\bar{A}^{02}_{x+t})\\
\left.\frac{\mathrm{d}\bar{A}^{02}_{x+t}}{\mathrm{d}t}\right|_{t=10} &= 0.05\bar{A}^{02}_{x+10} - 0.07(\bar{A}^{12}_{x+10} - \bar{A}^{02}_{x+10}) - 0.04(-\bar{A}^{02}_{x+10})
\end{aligned}$$

Change the second two displayed lines to

$$\begin{aligned}
\frac{\mathrm{d}\bar{A}^{24}_{x+t}}{\mathrm{d}t} &= \delta\bar{A}^{24}_{x+t} - \mu^{21}_{x+t}(\bar{A}^{14}_{x+t} - \bar{A}^{24}_{x+t}) - \mu^{23}_{x+t}(\bar{A}^{34}_{x+t} - \bar{A}^{24}_{x+t}) - \mu^{24}_{x+t}(b^{(4)} - \bar{A}^{24}_{x+t})\\
\left.\frac{\mathrm{d}\bar{A}^{24}_{x+t}}{\mathrm{d}t}\right|_{t=10} &= 0.05(\bar{A}^{24}_{x+10} - \bar{A}^{24}_{x+10}) - 0.01(\bar{A}^{14}_{x+10} - \bar{A}^{24}_{x+10}) - 0.12(\bar{A}^{34}_{x+10} - \bar{A}^{24}_{x+10}) - 0.10(1-\bar{A}^{24}_{x+t})
\end{aligned}$$

[9/21/2019] On page 920, on the third line of Example 47F, change "year death" to "year of death".

[9/21/2019] On page 921, on the second line after "If we assume the death benefit is paid...", the left side of the equation is missing $1+i$ and should be ${}_tV^{(1)}(1+i)$.

[9/7/2018] On page 928, in exercise 47.5, in statement (ii), change $i = 0.04$ to $\delta = 0.04$.

[9/21/2019] On page 939, in the solution to exercise 47.2, on the first line, a 36,500 is missing from the left side of the equation and 796.58 should be 756.58; the equation should read $1.05^{-1/2}(36{,}500)\ddot{a}^{01}_{45:\overline{20}|} = 1.05^{-1/2}(36{,}500)(0.02124) = 756.58$. On the second line, change $\bar{a}^{00}_{45:\overline{20}|} + \bar{a}^{01}_{45:\overline{20}|}$ to $\ddot{a}^{00}_{45:\overline{20}|} + \ddot{a}^{01}_{45:\overline{20}|}$.

[9/7/2018] On page 939, in the solution to exercise 47.4, on the last line, change ${}_tp_x^{0j}$ to ${}_0p_x^{0j}$.

[8/19/2018] On page 940, in the solution to exercise 47.6, change the last two lines to

$$\frac{\mathrm{d}\bar{a}^{11}_{57+t}}{\mathrm{d}t} = \delta\,\bar{a}^{11}_{57+t} - B_t^{(1)} - \mu^{10}_{57+t}(\bar{a}^{01}_{57+t} - \bar{a}^{11}_{57+t}) - \mu^{12}_{57+t}(-\bar{a}^{11}_{57+t}) - \mu^{13}_{57+t}(-\bar{a}^{11}_{57+t})$$

$$\left.\frac{\mathrm{d}\bar{a}^{11}_{57+t}}{\mathrm{d}t}\right|_5 = 0.05(4.3298) - 1 - 0.02(2.0216 - 4.3298) - (0.06 + 0.015)(-4.3298) = \boxed{\mathbf{-0.4126}}$$

[10/15/2018] On page 945, in the solution to exercise 47.22, 3 lines from the end, change $a_{50:\overline{3}|}$ to $\ddot{a}_{50:\overline{3}|}$.

[9/11/2018] On page 1030, replace the solution to exercise 51.7 with

$p^{(\tau)}_{50} = 114{,}572.5/117{,}145.5 = 0.978036$. Also,

$$\frac{q^{(w)}_{50}}{q^{(\tau)}_{50}} = \frac{d^{(w)}_{50}}{d^{(\tau)}_{50}} = \frac{2317.1}{2{,}317.1 + 115.9 + 140.1} = 0.900509$$

Using formula (51.2),

$$\begin{aligned} p'^{(w)}_{50} &= \left(p^{(\tau)}_{50}\right)^{q^{(w)}_{50}/q^{(\tau)}_{50}} \\ &= 0.978036^{0.900509} = 0.980199 \end{aligned}$$

Therefore, $q'^{(w)}_{50} = 1 - 0.980199 = \boxed{\mathbf{0.019801}}$.

[5/24/2019] On page 1067, in the solution to exercise 53.17, on the second line, delete the first left parenthesis in the first exponent.

[8/12/2018] On page 1260, in the solution to exercise 64.4, replace the displayed line with

$${}_{20}p_{18} = \frac{1 - F(38)}{1 - F(18)} = \frac{1 - 4/7}{1 - 2/7} = \boxed{\mathbf{0.6}}$$

[9/13/2018] On page 1268, on the second line of Example 65F, change both 44,100s to 49,000.

[10/8/2019] On page 1283, on the fourth line, change "mortality stdy" to "mortality study".

[10/8/2019] On page 1309, change the summation index in equation (68.1) to "$j \mid y_j \le t$".

[10/8/2019] On page 1346, four lines below the table, change "(64-10,67-7,s)" to "(64-10,67-2,s)".

[8/5/2018] On page 1354, on the fifth line of the answer to Example 69I, delete 0.9 from the sum.

[8/5/2018] On pager 1355, 2 lines below the table in the answer to Example 69J, change r_3 and r_5 to e_3 and e_5. In the subsequent calculations on the next 5 lines, change each r_i to e_i, where $i = 1,2,3,4,5$.

[10/4/2018] On page 1376, on the first displayed line, the expression between the two equal signs should be a fraction. Replace the line with

$$\sum_{k=0}^{19} 100{,}000(1.04^k) = \frac{100{,}000(1.04^{20} - 1)}{1.04 - 1} = 2{,}977{,}808$$

[9/13/2018] On page 1379, 2 lines below the first displayed line, change 0.7(9.3482)(2.032794) to 0.7(13.0027)(2.032794).

[9/26/2019] On page 1394, replace the solution to exercise 70.13 with

The number of lives leaving the job in between 2 and 4 years is $l_{42}^{(\tau)} - l_{44}^{(\tau)} = 152{,}631.0 - 137{,}656.1 = 14{,}974.9$. Of those, $i_{42}+i_{43} = 148.8+141.3 = 290.1$ leave due to disability. The quotient is $290.1/14{,}974.9 = \boxed{\mathbf{0.019372}}$.

[7/27/2018] On page 1400, on the third displayed line of the page, delete (25), (26), and (27), so that the line reads:

$$0.34(47{,}143.52)\left(\frac{(0.325857)(0.6)(13.1)}{1.05^5} + \frac{(0.053235)(0.8)(12.9)}{1.05^6} + \frac{(0.504927)(1)(12.7)}{1.05^7}\right) = \boxed{\mathbf{111{,}785.6}}$$

[10/6/2019] On page 1404, in Example 71D(vi), change "for each year before age 65" to "for each year or fraction of a year before age 65".

[10/12/2019] On pages 1405 and 1406, in both figures, change "Age" to "Service".

[7/29/2018] On page 1413, in the solution to exercise 71.2, on the first displayed line, place 100,000 before the fraction:

$$\text{Total pensionable earnings} = \sum_{k=-12}^{-1} 100{,}000(1.03^k) = 100{,}000\left(\frac{1-1/1.03^{12}}{1.03-1}\right) = 995{,}400.4$$

On the last line, a factor of 11.5 is missing. The line should read

$$995{,}400.4(0.035)(11.5)\left(\frac{0.95}{1.04}\right)^{13} = \boxed{\mathbf{123{,}520}}$$

[9/10/2019] On page 1418, in equations (72.4) and (72.5), change the summation index from i tp t: $\sum_{t=0}^{65-x}$.

[7/30/2018] On page 1419, replace the first sentence of the answer to Example 72B with

Out of 93,085.4 lives age 0, 27,925.6 retire immediately and an additional 6,187.6 retire during the first year, 5,573.1 retire at age 61, and 5,017.5 retire at age 62.

[9/10/2019] On page 1421, on the line below equation (72.3), add a -1:

where $i^* = \dfrac{1+i}{c(1+j)} - 1$.

In equations (72.4) and (72.5), change the summation index from i tp t: $\sum_{t=0}^{65-x}$

[8/8/2018] On page 1425, in the solution to exercise 72.4, on the second line from the end, put an exponent 15 on the first 0.998846:

$$\text{AVTHB} = 4000(0.998846^{15})\left(\frac{1-0.998846^5}{1-0.998846} + 0.998846^5\left(\frac{1}{1-0.978462}\right)\right)$$

[9/10/2019] On page 1435, on the second line below the heading **DPP**, change = to ≥:

$$\sum_{k=0}^{m} \Pi_k v^k \geq 0$$

[4/15/2019] On page 1458, in Table 74.1, the expense gain formula should split withdrawal settlement expenses ($E_k^{(w)}$) and death settlement expenses ($E_k^{(d)}$):

$$(e_k^* - e_k')(1+i) + q_{x+k-1}^{(d)}(E_k^{(d)*} - E_k^{(d)\prime}) + q_{x+k-1}^{(w)}(E_k^{(w)*} - E_k^{(w)\prime})$$

[9/10/2019] On page 1464, in the solution to exercise 74.8, 3 lines from the end, change $(15-10)$ to $(10-15)$.

[10/14/2018] On page 1515, in question 6(a), change 267,000 to 333,000.

[4/5/2019] On page 1526, in question 5, add to statement (ii): $q_{50} = 0.00592$.

[4/14/2019] On page 1538, in question 6(c), change 100,300 to 116,500.

[2/27/2019] On page 1566, on the line before question 5(c), change 6% to 5%. On the first line of question 5(c), change 270 to 410.

[10/31/2019] On page 1600, in question 6, on the ninth line, change "to not" to "do not".

[10/25/2018] On page 1626, in question 18(ii), replace "Illustrative Life Table" with "Standard Ultimate Life Table".

[10/6/2019] On page 1627, in question 20(iv), change the last sentence to "The benefit is reduced by 8

[8/30/2019] On page 1628, in question 2(b)(ii), change "healthy" to "sick".

[10/12/2019] On page 1642, the solution to question 8 has several errors. Replace everything after the third line with:

$$\begin{aligned}
{}_{19}E_{51} &= \frac{{}_{20}E_{50}(1.05)}{1-q_{50}} = \frac{0.34824(1.05)}{1-0.001331} = 0.36609\\
{}_{19|}\ddot{a}_{51} &= {}_{19}E_{51}\,\ddot{a}_{70} = (0.36609)(12.0083) = 4.3962\\
\pi &= \frac{A_{51}}{\ddot{a}_{51} + {}_{19|}\ddot{a}_{51}} = \frac{197.80}{16.8461+4.3962} = 9.3116
\end{aligned}$$

Now we calculate the reserve prospectively.

$$\begin{aligned}
{}_{10|}\ddot{a}_{60} &= {}_{10}E_{60}\,\ddot{a}_{70}\\
&= (0.57864)(12.0083) = 6.9485\\
{}_{10}V &= 1000A_{60} - \pi(\ddot{a}_{60} + {}_{10|}\ddot{a}_{60})\\
&= 290.28 - 9.3116\big(14.9041 + 6.9485\big) = \boxed{\mathbf{86.7970}}
\end{aligned}$$

[10/19/2019] On page 1652, in the solution to question 3(b), on the third line, change $100\ddot{a}_{60}$ to $100\bar{a}_{60}$.

[2/3/2019] On page 1653, on the last line of the page, change 95.2510 to 113.7567. Change the first line of page 1654 to

Multiplying by i/δ, we get $1.0248(113.7567) = \boxed{\mathbf{116.58}}$.

[2/6/2019] On page 1655, in the solution to question 5(b), change the final answer to 0.005215.

[2/13/2019] On page 1655, in the solution to question 6(b), change the final answer to 35,378.

[4/14/2019] On page 1662, in the solution to question 1(e), change the second line to

$$(2600-556)(1.05) - 0.00763(100{,}000) - (1-0.00763)(-1822.83) = \boxed{\mathbf{3192.12}}$$

[10/16/2018] On page 1663, replace the solution to question 2 with the following (there is no change to the solution to part (a)):

(a)

$$152{,}177.94\left(\frac{1.06^5}{1.05^5}\right) = 159{,}563.86$$
$$0.8(159{,}563.86) = \boxed{\mathbf{127{,}651.09}}$$

(b) First we calculate the probability that (62) will survive to 63, 64, and 65.

$$p_{62} = \frac{l_{63}}{l_{62}} = \frac{95{,}534.40}{95{,}940.60} = 0.995766$$
$${}_2p_{62} = \frac{l_{64}}{l_{62}} = \frac{95{,}082.50}{95{,}940.60} = 0.991056$$
$${}_3p_{62} = \frac{l_{65}}{l_{62}} = \frac{94{,}579.70}{95{,}940.60} = 0.985815$$

The EPV of retiree health benefits at age 60 for those retiring at age 62 is

$$6500\left(\frac{1.06^2}{1.05^2}\right) + 6600(0.995766)\left(\frac{1.06^3}{1.05^3}\right)$$
$$+6800(0.991056)\left(\frac{1.06^4}{1.05^4}\right) + (0.985815)(152{,}177.94)\left(\frac{1.06^5}{1.05^5}\right) = 174{,}349.35$$
$$0.2(174{,}349.35) = \boxed{\mathbf{35{,}537.22}}$$

(c) Using the results of the previous parts, we accrue 1/12 of the age 62 benefit and 1/15 of the age 65 benefit.

$$\frac{1}{12}(0.45)(174{,}349.35) + \frac{1}{15}(0.45)(159{,}563.86) = \boxed{\mathbf{11{,}325.02}}$$

(d) First, we'll remove the first three years of benefits from the expected present value at age 65. We must take into account Standard Ultimate Life Table mortality.

$$152{,}177.94 - 7000 - 7200p_{65}\left(\frac{1.06}{1.05}\right) - 7500\,{}_2p_{65}\left(\frac{1.06}{1.05}\right)^2$$
$$= 152{,}177.94 - 7000 - 7200\left(\frac{94{,}020.30}{94{,}579.70}\right)\left(\frac{1.06}{1.05}\right) - 7500\left(\frac{93{,}398.10}{94{,}579.70}\right)\left(\frac{1.06}{1.05}\right)^2 = 130{,}404.31$$

That would be the expected present value of retiree health benefits for a person age 65 in 2018 who retires in 2021. We divide this by ${}_3p_{65} = l_{68}/l_{65}$, remove three years of inflation, and accumulate interest for 3 years since we pay it 3 years earlier:

$$\frac{130{,}404.31}{92{,}706.10/94{,}579.70}\left(\frac{1.05}{1.06}\right)^3 = \boxed{\mathbf{129{,}309.93}}$$

[4/24/2019] On page 1679, in the solution to question 6(e), replace the last 3 lines with

$$116{,}545(1.05^20) + 4{,}621{,}746k = 0.5(210{,}685)(10.65)$$
$$309{,}229 + 4{,}621{,}746k = 1{,}121{,}897$$

Solving for k, we get $\boxed{\mathbf{0.17584}}$.

[10/17/2018] On page 1698, in the solution to question 18, replace the and fifth line with

$$p(51,2017) = 1 - 0.0091(0.98) = 0.991082$$
$${}_2p(50,2016) = (0.9915)(0.991082) = 0.982658$$

[10/18/2018] On page 1701, in the solution to question 4(a), two lines from the end, change final answer 0.0240 to 0.0230. In the solution to question 4(b), on the second line, replace 0.024 with 0.023 and replace 0.010871847 with 0.010882986.

[4/22/2019] On page 1701, in the solution to question 4(c), on the first line, change 0.01054575 to 0.010882986.

[10/18/2018] On page 1712, in the solution to question 5(a), on the second line, 12.9754 and 5.2422 should be interchanged so that the fraction is $\dfrac{1000(5.2422)}{12.9754}$.

[10/12/2019] On page 1715, in the solution to question 2, 2 lines from the end of the page, insert "Var" before $\bigl(S_n(y_k)\bigr)$.

[10/12/2019] On page 1717, the solution to question 8 has several errors. Replace everything after the third line with:

$${}_{19}E_{51} = \frac{{}_{20}E_{50}(1.05)}{1-q_{50}} = \frac{0.34824(1.05)}{1-0.001331} = 0.36609$$
$${}_{19|}\ddot{a}_{51} = {}_{19}E_{51}\,\ddot{a}_{70} = (0.36609)(12.0083) = 4.3962$$
$$\pi = \frac{A_{51}}{\ddot{a}_{51} + {}_{19|}\ddot{a}_{51}} = \frac{197.80}{16.8461 + 4.3962} = 9.3116$$

Now we calculate the reserve prospectively.

$$\begin{aligned} {}_{10|}\ddot{a}_{60} &= {}_{10}E_{60}\,\ddot{a}_{70} \\ &= (0.57864)(12.0083) = 6.9485 \\ {}_{10}V &= 1000A_{60} - \pi(\ddot{a}_{60} + {}_{10|}\ddot{a}_{60}) \\ &= 290.28 - 9.3116\bigl(14.9041 + 6.9485\bigr) = \boxed{\mathbf{86.7970}} \qquad \textbf{(A)} \end{aligned}$$

[10/31/2019] On page 1739, in the solution to question 2, on the fifth and seventh lines, replace 23,748 with 24,798.

[10/31/2019] On page 1748, in the solution to question 6(b), change the final answer from 175,194.6 to 36,584.02.

[10/25/2018] On page 1752, in the solution to question 7, replace 197,765.1 with 18,200.3 on lines 3 and 5, and replace the final answer 10,132 with 8,567.

[10/31/2019] On page 1761, in the solution to question 6(a), on the first displayed line, change 4,354.70 to 4,152.44. Change the final answer from 21,649.70 to 20,644.16.

[10/25/2018] On page 1764, change the answer key for question 7 to **(D)**. Make the same change to the answer key on page 1762

[8/30/2019] On page 1770, in the solution to question 4(b), on the third line, change 0.02(64.9) to 0.02(29.9).

[10/19/2018] On page 1772, in the solution to question 5(c), on the last line, change $\dfrac{9}{29}$ to $\dfrac{10}{29}$ and change the final answer to $\boxed{\mathbf{10{,}321.95}}$.

[10/25/2018] On page 1776, in the solution to question 10, in the table, replace the entry for ${}_{t-1}V$ for $t = 1$ with 0, since this reserve is ignored. Replace the entry for Pr_t for $t = 1$ with 137.178.

[10/25/2018] On pages 1778–1779, replace the solution to question 17 with

We can either calculate single premiums for insurances or annuities. Using insurances:

$$
\begin{aligned}
A_{55:\overline{10}|} &= 0.61813\\
A_{65:\overline{10}|} &= 0.62650\\
{}_{10}E_{55:65} &= \left(\frac{l_{75}}{l_{55}}\right)\left(\frac{1}{1.05^{10}}\right) = {}_{20}E_{55}(1.05^{10}) = 0.32819(1.05^{10}) = 0.53459\\
A_{55:65:\overline{10}|} &= A_{55:65} - {}_{10}E_{55:65}A_{65:75} + {}_{10}E_{55:65} = 0.38891 - 0.53459(0.54810) + 0.53459 = 0.63049\\
A_{\overline{55:65}:\overline{10}|} &= 0.61813 + 0.62650 - 0.63049 = 0.61414
\end{aligned}
$$

Then the annual net premium is

$$
\begin{aligned}
P_{\overline{55:65}:\overline{10}|} &= \frac{dA_{\overline{55:65}:\overline{10}|}}{1 - A_{\overline{55:65}:\overline{10}|}}\\
&= \frac{(0.05/1.05)0.61414}{1 - 0.61414} = 0.07579
\end{aligned}
$$

The answer is $1000(0.07579) = \boxed{\mathbf{75.79}}$.

[10/25/2018] On page 1779, replace the solution to question 18 with

We must start with $A^{\,1}_{67:\overline{18}|}$ and work back recursively.

$$
\begin{aligned}
A^{\,1}_{67:\overline{18}|} &= \frac{A^{\,1}_{65:\overline{20}|} - vq_{65} - v^2 p_{65} q_{66}}{{}_2E_{65}}\\
&= \frac{0.43371 - 0.24381 - \frac{0.005915}{1.05} - \frac{(1-0.005915)(0.006619)}{1.05^2}}{(93{,}398.1/94{,}579.7)/1.05^2}\\
&= 0.19906
\end{aligned}
$$

Doubling μ squares p_{66}, so the revised values are

$$
\begin{aligned}
p_{66} &= (1 - 0.006619)^2 = 0.986806\\
q_{66} &= 1 - 0.986806 = 0.013194
\end{aligned}
$$

Now we do two recursions.

$$
\begin{aligned}
A^{\,1}_{66:\overline{19}|} &= v(p_{66}A^{\,1}_{67:\overline{18}|} + q_{66})\\
&= \frac{0.986806(0.19906) + 0.013194}{1.05} = 0.19965\\
A^{\,1}_{65:\overline{20}|} &= v(p_{65}A^{\,1}_{66:\overline{19}|} + q_{65})\\
&= \frac{0.994085(0.19965) + 0.005915}{1.05} = 0.19465\\
1000A^{\,1}_{65:\overline{20}|} &= 1000(0.19465) = \boxed{\mathbf{194.65}} \qquad \textbf{(B)}
\end{aligned}
$$