

## Errata and Updates for ASM Exam LTAM (First Edition) Sorted by Date

[11/21/2019] On page 1447, on the last line of the page, change 60,331.24 to 46,067.59.

[8/9/2019] On page 201, in the solution to exercise 10.17, on the second line, change  $0.01Z_{2017}^{(2)}$  to  $0.05Z_{2017}^{(2)}$ .

[4/22/2019] On page 201, in the solution to exercise 10.17, on the third line from the end, change  $lm(80, 2017)$  to  $lq(80, 2017)$ .

[4/22/2019] On page 1761, in the solution to question 4(c), on the first line, change 0.01054575 to 0.010882986.

[4/15/2019] On page 1507, in Table 74.1, the expense gain formula should split withdrawal settlement expenses ( $E_k^{(w)}$ ) and death settlement expenses ( $E_k^{(d)}$ ):

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

[4/14/2019] On page 1720, in the solution to question 1(e), change the second line to

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

[4/7/2019] On page 922, on the third displayed line,  $(1+i)^h$  is missing from the left side. Change the line to

$${}_tV^{(1)}(1+i)^h = {}_h p_{x+t}^{11} ({}_h B_{t+h}^{(1)} + {}_{t+h}V^{(1)})$$

[3/19/2019] On page 216, in equations (12.1) and (12.2), change  $b_k$  to  $b_{k+1}$  twice in each equation.

[2/6/2019] On page 1711, in the solution to question 5(b), change the final answer to 0.005215.

[10/25/2018] On page 1825, change the answer key for question 7 to **(D)**. Make the same change to the answer key on page 1823.

[10/25/2018] On page 1837, 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  $\text{Pr}_t$  for  $t = 1$  with 137.178.

[10/19/2018] On page 1833, in the solution to question 5(c), on the last line, change  $\frac{9}{29}$  to  $\frac{10}{29}$  and change the final answer to  $\boxed{10,321.95}$ .

[10/18/2018] On page 1761, 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.

[10/17/2018] On page 1758, in the solution to question 18, replace the and fifth line with

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

[10/16/2018] On page 191, on the last line of the answer to Example 10H, change  ${}_3p_{70}$  to  ${}_3p_{77}$ .

[10/16/2018] On pages 1720–1721, replace the solution to question 2 with the following (there is no change to the solution to part (a)):

(a)

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

- (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

$$6500\left(\frac{1.06^2}{1.05^2}\right) + 6600(0.995766)\left(\frac{1.06^3}{1.05^3}\right)$$

$$+ 6800(0.991056)\left(\frac{1.06^4}{1.05^4}\right) + (0.985815)(152,177.94)\left(\frac{1.06^5}{1.05^5}\right) = 174,349.35$$

$$0.2(174,349.35) = \boxed{35,537.22}$$

- (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.

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

- (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:

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

[10/15/2018] On page 978, in the solution to exercise 47.22, 4 lines from the end, change  $a_{50:\overline{3}|}$  to  $\ddot{a}_{50:\overline{3}|}$ .

[10/4/2018] On page 1422, on the first displayed line, the expression between the two equal signs should be a fraction. Replace the line with

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

[10/4/2018] On page 1427, the displayed lines two lines below the table represent the accrued benefit under PUC rather than the expected present value of benefits. Replace it with

$$0.017\left(\frac{3,552}{27,006} \frac{(0.6)(13.1)(25)(54,652.26)}{1.05^5} + \frac{1,587}{27,006} \frac{(0.8)(12.9)(26)(56,291.83)}{1.05^6}\right)$$

$$+ \frac{18,106}{27,006} \frac{(12.7)(27)(57,980.59)}{1.05^7} = \boxed{191,114.8}$$

- [9/29/2018] On page 200, in the solution to exercise 10.10, on the second line, replace both 0.12s with 0.07s.
- [9/20/2018] On page 947, on the second line, in the first integral, change  $\mu_{x+t}$  to  $\mu_{x+t}^{01}$ . In the second integral, change  $\bar{a}_{x+t:\overline{n-(x+t)}}^{\overline{11}}$  to  $\bar{a}_{x+t:\overline{n-t}}^{\overline{11}}$ .
- [9/13/2018] On page 1311, on the second line of Example 65F, change both 44,100s to 49,000.
- [9/7/2018] On page 961, in exercise 47.5, in statement (ii), change  $i = 0.04$  to  $\delta = 0.04$ .
- [9/7/2018] On page 972, in the solution to exercise 47.4, on the last line, change  ${}_t p_x^{0j}$  to  ${}_0 p_x^{0j}$ .
- [9/4/2018] On page xix, in the caption of the table, change “MLC” to “LTAM”.
- [9/4/2018] On page 840, one line above Example 42C, change “is is” to “it is”.
- [9/4/2018] On page 879, on the last line of the first paragraph, change “atate” to “state”.
- [9/4/2018] On page 951, in the answer to Example 47B, change the second through fourth lines of the page to

$$\begin{aligned} \frac{d_t V^{(1)}}{dt} &= \delta_{10} V^{(1)} - \mu_{x+10}^{10} ({}_{10}V^{(0)} - {}_{10}V^{(1)}) - \mu_{x+10}^{12} ({}_{10}V^{(2)} - {}_{10}V^{(1)}) \\ &\quad - \mu_{x+10}^{13} ({}_{10}V^{(3)} - {}_{10}V^{(1)}) - \mu_{x+10}^{14} ({}_{-10}V^{(1)}) \\ &= (0.05)(45,000) - 0.06(20,000 - 45,000) - 0.14(150,000 - 45,000) \\ &\quad - 0.08(400,000 - 45,000) - 0.02(45,000) \\ &= \boxed{-38,450} \end{aligned}$$

- [8/31/2018] On page 671, in the solution to exercise 33.3, on the seventh displayed line, change the denominator 0.04/1.04 to 0.039211. Change the last displayed line of the solution to

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

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

$$\begin{aligned} \frac{d\bar{a}_{57+t}^{11}}{dt} &= \delta \bar{a}_{57+t}^{11} - B_t^{(1)} - \mu_{57+t}^{10} (\bar{a}_{57+t}^{01} - \bar{a}_{57+t}^{11}) - \mu_{57+t}^{12} (-\bar{a}_{57+t}^{11}) - \mu_{57+t}^{13} (-\bar{a}_{57+t}^{11}) \\ \frac{d\bar{a}_{57+t}^{11}}{dt} \Big|_5 &= 0.05(4.3298) - 1 - 0.02(2.0216 - 4.3298) - (0.06 + 0.015)(-4.3298) = \boxed{-0.4126} \end{aligned}$$

- [8/12/2018] On page 200, in the solution to exercise 10.13, on the last line, change 0.062431 to 0.00057305 and change 0.24986 to 0.023938.

- [8/12/2018] On page 1302, in the solution to exercise 64.4, replace the displayed line with

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

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

- [8/8/2018] On page 1472, in the solution to exercise 72.4, on the second line from the end, put an exponent 15 on the first 0.998846:

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

[8/5/2018] On page 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 calculations on the 5 subsequent lines, change each  $r_i$  to  $e_i$ , where  $i = 1, 2, 3, 4, 5$ .

[8/3/2018] On pages 951–952, in the answer to Example 47C, change the sentence on the third line beginning “Once” to:

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

Change the first two displayed lines to:

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

Change the second two displayed lines of the answer, which are the first two displayed lines on page 952, to

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

[7/29/2018] On page 1459, 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

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

[7/17/2018] On page 1461, in the solution to exercise 71.8, in the last displayed line, change 0.23125 to 0.2325.

[5/15/2018] On page 1857, in the solution to question 7(a), on the third line, change 5000 to 3000.

[5/13/2018] On page 938, delete footnote 1. The revised version of the study note corrected the error.

[5/13/2018] On page 1465, in the answer to Example 72B, on the first line, change 313 to 3552, 298 to 1587, and 284 to 2692.

[5/8/2018] On page 2031, in the solution to question 4(b), on the second to last line, change  $+0.96G$  to  $-0.96G$ .

[4/29/2018] On page 946, on the last line, change  $\bar{a}_{x+t:\overline{n-(x+t)|}}$  to  $\bar{a}_{x+t:\overline{n-t}|}$ .

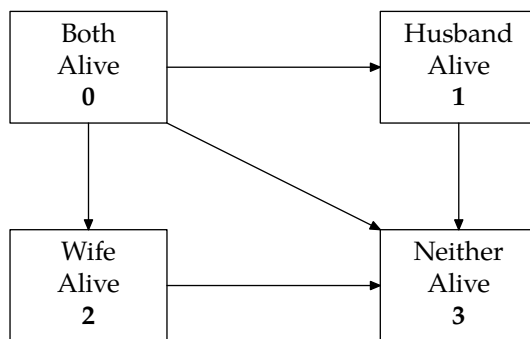
[4/29/2018] On page 1330, in the first bullet, change “ $y > y_{\max}$ ” to “ $y \geq y_{\max}$ ”. In the second line of the second bullet, change “ $S_n(y_{\max}), y_{\max} < y < \gamma$ ” to “ $S_n(y_k), y_{\max} \leq y < \gamma$ ”. Two lines below the second bullet, change “ $S_n(y_{\max})^{y/y_{\max}}$ ” to “ $S_n(y_k)^{y/y_{\max}} \quad y \geq y_{\max}$ ”.

[4/29/2018] On page 1331, on the last line, change “ $S_n(y_{\max}) > 0$ ” to “ $S_n(y_k) > 0$ ”.

[4/29/2018] On page 1332, in Table 66.1, on the last line, change the formula to “ $\hat{S}(t) = \hat{S}(y_k)^{t/y_{\max}} \quad t \geq y_{\max}$ ”.

[4/29/2018] On page 1332, in exercise 66.1, on the last line, change “ $S(2)$ ” to “ $S(1.8)$ ”.

- [4/12/2018] On page 189, in Example 10G part 3, change “part (b)” to “part 2”.
- [4/12/2018] On page 1424, in Example 70E, change “He” to “She” on the first line. Change “His” to “Her” on the second line.
- [4/11/2018] On page 880, Figure 44.7 is incorrect. The correct figure is



- [4/11/2018] On page 1195, Figure 44.7 is incorrect. See the erratum for page 880 for the correct figure.
- [4/10/2018] On page 1367, on the fourth line of the Confidence Intervals section, delete “th” after “100p<sup>th</sup>”.
- [4/8/2018] On page 187, on the first lines of the answer to Example 10E, both part 1 and part 2, change  $l m(40, t + 1)$  to  $m(40, t + 1)$ ,
- [4/4/2018] On page 197, in the solution to exercise 10.1, on the first line, change  $(1 - 0.005)^5$  to  $(1 - 0.005)^t$ .
- [4/4/2018] On page 199, in the solution to exercise 10.7, on the last line, change 0.0149095 to 0.0148095.
- [4/4/2018] On page 923, replace the solution to Example 46I with the following:

Since the period is 1/12 of a year, the claims acceleration approach multiplies the death benefit by  $1.04^{1/24}$ . The recursion equations are

$$\begin{aligned} ({}_5V^{(0)} + P)(1.04^{1/12}) &= {}_{1/12}p_{x+5}^{00} {}_{5 \frac{1}{12}}V^{(0)} + {}_{1/12}p_{x+5}^{01} {}_{5 \frac{1}{12}}V^{(1)} + {}_{1/12}p_{x+5}^{02} (50,000)(1.04^{1/24}) \\ ({}_5V^{(1)} - 5000)(1.04^{1/12}) &= {}_{1/12}p_{x+5}^{10} {}_{5 \frac{1}{12}}V^{(0)} + {}_{1/12}p_{x+5}^{11} ({}_5 \frac{1}{12}V^{(1)}) + {}_{1/12}p_{x+5}^{12} (50,000)(1.04^{1/24}) \end{aligned}$$

We'll have to solve these simultaneously. Note that

$$\begin{aligned} {}_{1/12}p_{x+5}^{02} &= 1 - 0.94328 - 0.05020 = 0.00652 \\ {}_{1/12}p_{x+5}^{12} &= 1 - 0.12061 - 0.86029 = 0.01910 \\ 50,000(1.04^{1/24}) &= 50,081.78 \end{aligned}$$

The recursions are

$$\begin{aligned} (6,248.35 + 500)(1.04^{1/12}) &= 0.94328 {}_{5 \frac{1}{12}}V^{(0)} + 0.05020 {}_{5 \frac{1}{12}}V^{(1)} + 0.00652(50,081.78) \\ (25,022.07 - 5000)(1.04^{1/12}) &= 0.12061 {}_{5 \frac{1}{12}}V^{(0)} + 0.86029 {}_{5 \frac{1}{12}}V^{(1)} + 0.01910(50,081.78) \end{aligned}$$

Solving these equations,

$$\begin{aligned} 0.94328 {}_{5 \frac{1}{12}}V^{(0)} + 0.05020 {}_{5 \frac{1}{12}}V^{(1)} &= 6,443.91 \\ 0.12061 {}_{5 \frac{1}{12}}V^{(0)} + 0.86029 {}_{5 \frac{1}{12}}V^{(1)} &= 19,131.06 \\ {}_{5 \frac{1}{12}}V^{(0)} &= \boxed{5,690.37} \end{aligned}$$

$${}_{5\frac{1}{12}}V^{(1)} = \boxed{21,440.15}$$

- [4/4/2018] On page 1399, on the first line of the page, delete +0.9.
- [3/30/2018] On page 1296, on the second line of the page, the line for  $F_{100}(x)$ , the last line of the braced lines should be 0.05  $x = 64$ .
- [1/25/2018] On page 288, two lines above Example 14G, add “for” between “benefits” and “a coverage”.
- [1/25/2018] On page 530, 5 lines from the bottom of the page, change 45 to (45).
- [1/25/2018] On page 681, on the fourth line of Example 34C, change “age (50)” to “age 50”.
- [1/8/2018] On page 2028, in the solution to part (a) of question 1, on the third line, delete the minus sign in front of  $(0.04 + 0.01t)dt$ .
- [1/8/2018] On page 2028, in the solution to part (c)(i) of question 1, replace  ${}_t p_{40+t}^{00}$  with  ${}_t p_{40}^{00}$ . On page 2029, in the solution to part (c)(ii) of question 1, replace  ${}_t p_{40+t}^{01}$  with  ${}_t p_{40}^{01}$ . Also on page 2029, in the solution to part (d) of question 1, replace the last line with the following two lines:

$${}_{0.2}p_{40}^{01} = 0.003 + 0.1((0.996)(0.03) - 0.003(0.01 + 0.012)) = 0.005981$$

The expected number of disableds is  $100(0.005981) = \boxed{0.5981}$ .

- [1/8/2018] On page 2038, in the solution to question 1(a)(i), on the first line, change  $a_{50:\overline{10}|}$  to  $\ddot{a}_{50:\overline{10}|}$ . In the solution to question 1(d), on the second line, change  $A_{51:\overline{9}|}$  to  $A_{51:\overline{19}|}$  and  $\ddot{a}_{51:\overline{9}|}$  to  $\ddot{a}_{51:\overline{9}|}$ .
- [1/8/2018] On page 2042, in the solution to question 6(a), on the first line, change  ${}_j p_x^{0j}$  to  ${}_t p_x^{0j}$ .
- [1/7/2018] On page 2031, replace the line for the solution to question 3 with “Question 3 is not on the current LTAM syllabus.”.
- [1/6/2018] On page 2030, replace the solution to part (d) of question 2 with

The single premium we want is the present value of benefits for death at time  $x > 10$ , where the probability of death between time 10 and time  $x$  equals 40%, since the present value of benefits is less than the present value of benefits for death at time  $x$  when death occurs before time 10 or after time  $x$ . In other words, we want  $x$  such that

$$\frac{l_{50} - l_x}{l_{40}} = 0.4$$

Now,  $l_{40} = 9,313,166$  and  $l_{50} = 8,950,901$ , so we want

$$\begin{aligned} 8,950,901 - l_x &= 0.4(9,313,166) = 3,725,266.4 \\ l_x &= 5,225,635.6 \end{aligned}$$

But the age  $y$  such that  $l_y = 5,225,635.6$  is greater than 75. So it suffices to cover the loss if death occurs after age 75 or before time 10, and the highest benefit payable for deaths at those times is the pure endowment benefit payable for deaths after age 75. This has present value  $50,000/1.06^{35} = \boxed{6,505.26}$ .