

## Errata and Updates for ASM Exam MLC (Fourteenth Edition Second Printing) Sorted by Page

Practice Exam 7:25 (page 1427) is defective,

[11/24/2014] On page 16, in the solution to exercise 1.11, on the last line, put a right parenthesis after  $\Pr(X < 1/2)$ .

[2/7/2015] On page 22, 9 lines above equation (2.4), change “sam” to “same”.

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

$$S_0(x) = 1 - \frac{x}{\omega}, \quad 0 \leq x \leq \omega$$

[11/24/2014] On page 102, in the solution to exercise 5.17, on the second displayed line, cube the first 50 in the numerator and denominator so that it reads

$$\frac{50^3 / (50 + (20 + t))^3}{50^3 / (50 + 20)^3}$$

[1/6/2015] On page 102, in the solution to exercise 5.19, on the second displayed line, change  ${}_{20}p_{10}$  to  ${}_{20}p_{10}$ .

[11/24/2014] On page 107, in the solution to exercise 5.34, on the second line, change “probability of death at” to “probability of death after”.

[12/14/2014] On page 174, in the solution to exercise 8.31, the parts should be numbered (a), (b), (c) rather than 1., 2., 3. On the second line of the solution to part (c), change  $1 - 0.882353t$  to  $1 - (1 - 0.882353)t$ .

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

[12/14/2014] On page 222, in the solution to exercise 10.51, on the second line, put a negative sign before  $Bc^{50}$ .

[2/12/2015] On page 243, 2 lines above “Solutions”, delete “F05:35”.

[8/5/2015] On page 253, in the warning box at the beginning of Section 12.1, on the second to last line, replace `sect:AbarNormalApprox` with 12.4.

[12/14/2014] On page 267, in exercise 12.29(c), change “of” to “of”.

[12/14/2014] On page 325, in the solution to exercise 14.15, the parts should be numbered (a) and (b) instead of 1. and 2. In part (a), on the last line, change  ${}_{10|q}_{60}$  to  ${}_{10|q}_{50}$ .

[3/3/2015] On page 331, in the solution to exercise 14.34, on the second line, put a negative sign before  $(0.05t + 0.01t^2)$  at the right:  $\exp(-(0.05t + 0.01t^2))$ .

[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  $k \geq \min(n + m, K_x + 1)$ .

[8/7/2015] On page 352, on the first line of Section 17.2, replace “life annuity-due” with “whole life 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  $n = 1$ .

[12/15/2014] On page 416, in exercise 19.27, on the second line, change  $v_x^T$  to  $v^{T_x}$ .

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

- [2/25/2015] On page 520, on the third displayed line of the answer to Example 25E, change  $\bar{a}_{60:\overline{10}|}$  to  $\ddot{a}_{60:\overline{10}|}$ .
- [1/24/2015] On page 537, in the solution to exercise 25.27. on the third line, change 0.18930 to 0.189965. On the last line, change 18,930 to 18,996.5 and change 2931.54 to 2941.82.
- [12/18/2014] On page 561, in the solution to exercise 27.13, on the second to last line, change 2.58047 to 2.58046.
- [8/16/2015] On page 577, in the solution to exercise 28.10, change  $a_{41}$  to  $a_{40}$  in two places: on the second line and on the seventh line.
- [12/18/2014] On page 592, in exercise 29.23, the first column of the table is missing. The table should be:

	Percent of premium	Per policy
First year	65%	150
Renewal	5%	15

- [2/12/2015] On page 610, one line above “Solutions”, add “F05:35” to the “Additional old CAS Exam 3/3L questions” list.
- [12/18/2014] On page 615, in the solution to exercise 30.20, on the fourth line, put a bar over the A in  $A_x^2$ .
- [5/3/2015] On page 668, in exercise 34.7(iii), delete the strange symbol before 13.
- [12/18/2014] On page 675, on the second to last line of the solution to exercise 34.5, delete 1000 before  ${}_{10}V$ .
- [3/11/2016] On page 711, in the solution to exercise 36.13, on the third displayed line,  $a_{x:\overline{10}|}$  should be  $\ddot{a}_{x:\overline{10}|}$ .
- [12/18/2014] On page 724, in exercise 37.18, on the displayed line, replace  $l - K$  with  $1 - K$ .
- [5/3/2015] On page 777, in exercise 39.47(ii), delete one of the “reserves”.
- [5/3/2015] On page 781, in exercise 39.60, on the first line, change “life” to “life”.
- [12/21/2014] On page 787, in the solution to exercise 39.10, on the first displayed line, delete “1000” before  $P_{68}\ddot{a}_{85:\overline{3}|}$ ”.
- [12/21/2014] On page 793, in the solution to exercise 39.35(c), change  $T_{x+1} = 1$  to  $T_{x+1} \leq 1$ .
- [2/1/2015] On page 775, in the solution to exercise 39.59, on the first displayed line, change the first minus sign to an equals sign.
- [5/22/2016] On page 813, in the solution to exercise 40.15, on the first line, change 2–10 to 2–20.
- [5/3/2015] On page 822, in the second paragraph of the page, on the first line, change “the policy is a” to “the policy if a”.
- [12/21/2014] On page 835, in exercise 41.38, on the last line, change  $1000b_{20}$  to  $b_{20}$ .
- [12/21/2014] On page 841, in the solution to exercise 41.17(b), on the sixth line, change  ${}_{t-h}p_{x+t}$  to  ${}_{t-h}p_{x+h}$ .
- [12/21/2014] On page 841, in the solution to exercise 41.29, on the last displayed line, change  $1 - \frac{13.2668}{14.8166}$  to  $1000 \left( 1 - \frac{13.2668}{14.8166} \right)$ .
- [12/21/2014] On page 845, in the solution to exercise 41.32, on the first displayed line, delete 50,000.
- [10/28/2015] On page 847, in the solution to exercise 41.35, change the final answer from 0.1425 to 0.1415 in two places.

- [10/12/2015] On page 889, in exercise 44.16, on the second-to-last line, change  ${}_2p_1^{12}$  to  ${}_2p_0^{12}$ .
- [8/30/2015] On page 892, on the second-to-last line of the solution to exercise 44.7, change (44.8) to (44.9).
- [12/21/2014] On page 977, in the solution to exercise 47.28, on the first displayed line, remove the parentheses around the subscript  $(T, J)$ .
- [12/21/2014] On page 994, in the solution to exercise 48.18, on the twelfth line, replace  $q_{64}^{(2)}$  with  ${}_2q_{64}^{(1)}$ .
- [3/29/2015] On page 1007, in exercise 49.17, on the last line, a negative sign is missing on the right hand side of the equation, which should be  $-q_{30}'^{(1)} \cdot q_{30}'^{(2)} / (\ln q_{30}'^{(1)})$ .
- [12/21/2014] On page 1007, in the solution to exercise 49.1, 2 lines from the end, replace  ${}_{2.5}p_x'^{(d)}$  with  ${}_{2.5}p_{65}'^{(d)}$ .
- [11/23/2014] On page 1008, in the solution to exercise 49.5, on the last line, change  $p_{41}'^{(1)}$  to  $q_{41}'^{(1)}$ .
- [3/29/2015] On page 1013, in the solution to exercise 49.17, 4 lines from the end, put negative signs in front of  $\ln p_{30}'^{(1)}$  and  $\ln(1 - q_{30}'^{(1)})$ . 3 lines from the end, put negative signs in front of each of the two fractions. On the last line, put a negative sign in front of  $\frac{q_{30}'^{(1)} q_{30}'^{(2)}}{\ln(1 - q_{30}'^{(1)})}$ .
- [12/23/2014] On page 1123, in exercise 56.16(ii), the end of the line after the comma should read “ $i = 0.05$ ”.
- [11/24/2014] On page 1126, in the solution to exercise 56.1, on the last line, change  $t$  in the exponent of the numerator to 5.
- [10/22/2015] On page 1130, in the solution to exercise 56.16, on the displayed line, change the left side to  ${}_{10}q_{50:40}^1$ .
- [12/23/2014] On page 1139, in the solution to exercise 57.1, change  ${}_i p_{50:55}^{00}$  to  ${}_{20} p_{50:55}^{00}$ .
- [3/22/2016] On page 1140, in the solution to exercise 57.5, on the third-to-last line, change  $0.05 / (0.005 + 2(0.03))$  to  $0.005 / (0.005 + 2(0.03))$
- [5/3/2015] On page 1164, in exercise 58.45(2), change “8ill” to “Bill”.
- [5/3/2015] On page 1164, in exercise 58.46, on the second line, change “m9ment” to “moment”.
- [5/3/2015] On page 1167, in exercise 58.53, on the third-to-last line, delete the first “that”.
- [12/23/2014] On page 1175, in the solution to exercise 58.27, on the second to last line, change “first death” to “last death”.
- [12/23/2014] On page 1175, in the solution to exercise 58.29 part 1, on the first line, insert  $v^t$  before  ${}_i p_{xy}$ :

$$\bar{a}_{xy} = \int_0^{\infty} v^t {}_i p_{xy} dt$$

- [12/23/2014] On page 1193, in exercise 59.17, in answer choice (D), change the last summand to  $15 {}_n | \bar{a}_y$ .
- [11/26/2014] On page 1204, in the solution to exercise 59.28, on the second line, change 0.06 to 0.6 and 0.13 to 1.3. On the last line, change 0.06 to 0.6.
- [4/12/2015] On page 1216, on the last line of the page, change 3.2787 to 3.2887.
- [4/12/2015] On page 1220, the final answer to Example 61E part 1 should be 143,002.3 instead of 153,830.1. The answer to part 2 should be 191,114.8 instead of 205,872.4.
- [5/2/2016] On page 1222, on the third line of the answer to Example 61G, change “57 and 58” to “58 and 59”.

- [10/15/2015] On page 1222, on the eighth line of the answer to Example 61G, change “to age 65” to “from age 65 to age 60”.
- [3/16/2015] On page 1232, in the solution to exercise 61.3, on the last line, replace  $ddx$  with  $dx$ .
- [12/23/2014] On page 1232, in the solution to exercise 61.5, on the last displayed line, change  $r^{361} - r$  in the numerator to  $r - r^{361}$ .
- [3/9/2015] On page 1234, in the solution to exercise 61.13, change  $l_{44}^{(\tau)} - l_{42}^{(\tau)}$  to  $l_{42}^{(\tau)} - l_{44}^{(\tau)}$ .
- [4/14/2015] On page 1235, in the solution to exercise 61.18, on the last line, change 9,146,051 to 9,164,051 and change the final answer to 50,639.21.
- [5/3/2015] On page 1243, in exercise 62.4, on the first line, change “an effective” to “as effective”.
- [11/26/2014] On page 1247, in the solution to exercise 62.3, on the last line, put “ - 1 before the second equals sign.
- [11/26/2014] On page 1250, in the solution to exercise 62.15, on the seventh line, change 825 to 2500.
- [5/3/2015] On page 1281, one line above Section 65.2, change “too” to “to”.
- [3/25/2016] On page 1282, in equation (65.3), the lower limit of the sum should be  $j = 0$  instead of  $j = 1$ .
- [2/15/2016] On page 1283, 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%,  $a_{[50]:5}^{(\tau)} = 2.72267$  and  $\ddot{a}_{[50]:5}^{(\tau)} = 3.39504$ .

Determine the premium needed.

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

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.

$$165.52 + 2.858005G - 5716.01 = 0.101851G$$

$$2.756154G = 6122.091$$

$$G = \boxed{2221.24} \quad \square$$

- [2/16/2015] On page 1285, 5 lines above Section 65.4, change 678.99 to 97.73.
- [12/23/2014] On page 1300, in the solution to exercise 65.17, on the seventh line, the formula for  $P$ , replace 25 in the denominator with 26; it is  $1/d$ .
- [4/8/2016] On page 1306, on the first displayed line, change 1399.19 to 1390.19.
- [12/23/2014] On page 1311, in the solution to exercise 66.3, on the second line, replace  $0.29327 - (0.71124)(0.42522) + 0.42522$  with  $0.29327 - (0.49247)(0.42522) + 0.49247$ . On the third line, change 0.41606 to 0.57633.
- [12/23/2014] On page 1357, in the solution to exercise 68.7, replace the last line with  
The gain, the excess of actual over expected profits is  $25.9 - 62.1125 = \boxed{-36.2125}$ .
- [12/21/2015] On page 1359, on the last line, change "Uninsured" to "Uninsurable".
- [8/23/2015] On page 1427, question 25 is defective since it is missing the expected present value of the retirement annuity. Answers to (b) and (c) should be multiplied by that expected present value.
- [4/5/2016] On page 1510, in question 26(iv), delete "for at most 10 years". In part (c) of the question, change  $v^k$  to  $v^{0.25k}$ .
- [3/3/2015] On page 1523, the answer key for practice exam 2 should be

1	A	6	A	11	D	16	C	21	E
2	D	7	B	12	E	17	E	22	C
3	B	8	A	13	D	18	A	23	C
4	C	9	D	14	D	19	D	24	C
5	D	10	A	15	C	20	E	25	D

- [4/1/2016] On page 1528, in the solution to question 17, change the upper right entry of the matrix from 0 to  $p_{03}$ . Change the last sentence to "III is false since  $p_{03}$  is not necessarily 0 whether or not the lives are independent. (E)"
- [3/3/2015] On page 1547, in the solution to question 14, on the third line, change  $s + 1$  to  $x + 1$ . On the fourth line, change "is" to "to".
- [5/3/2015] On page 1569, the correct answer choice for question 20 is (B). Correct the table on page 1561 as well.
- [4/17/2016] On page 1611, replace the solution to question 25 with

- (a) The direct way to do this is to integrate  $t$  times the density function for the husband's survival, which is  ${}_t p_x^{00} \mu^{02} + {}_t p_x^{01} \mu^{13}$ , 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  $\int_0^\infty t e^{-ct} dt = 1/c^2$ .

$$\begin{aligned} \int_0^\infty t {}_t p_x^{00} \mu^{02} dt &= \int_0^\infty 0.03 t e^{-0.05t} dt = \frac{0.03}{0.05^2} = 12 \\ \int_0^\infty {}_t p_x^{00} \mu^{01} \int_0^\infty (t+u) {}_u p_{x+t}^{11} \mu^{13} du dt &= \int_0^\infty 0.02 e^{-0.05t} \int_0^\infty (t+u)(0.04) e^{-0.04u} du dt \\ &= \int_0^\infty 0.02 e^{-0.05t} \left( \frac{1}{0.04} + t \right) dt \\ &= \frac{1}{2(0.05)} + \frac{0.02}{0.05^2} = 10 + 8 = 18 \end{aligned}$$

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

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  $20 + 0.4(25) = \boxed{30}$ .

- (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

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

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

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  $20 + 0.4(25) + 0.6(33\frac{1}{3}) = \boxed{50}$ .

[3/23/2016] On page 1640, in the solution to question 7, on the first line, replace  ${}_2 q_{60}'^{(2)}$  with  ${}_2 q_{60}'^{(1)}$ . On the last line, replace 0.89442 with 0.89443.

[1/16/2016] On page 1654, in the solution to question 13, line 5 to 2 from the end with

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

[8/25/2015] On page 1659, in the solution to question 25(c), on the second to last line, put a minus sign in front of  $\frac{0.02}{0.015}$ . Change the last line to

$$= -\frac{4}{3}e^{-0.8125} (e^{-0.0075(15^2)} - e^{-0.0075(5^2)}) = \boxed{0.381059}$$

[4/5/2016] On page 1683, in the solution to question 26(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.

[4/5/2016] On page 1684, in the solution to question 27(b), replace 60,957 with 81,688.

[4/15/2015] On page 1686, in the solution to question 26, on the last line, change "age 25" to "age 20".

[2/26/2015] On page 1725, in the solution to question 12, on the second line, change  $\ddot{a}_{x:\overline{2}}$  to  $a_{x:\overline{2}}$ .

[4/25/2016] On page 1741, in the solution to question 5, on the third line from the end, change  $4A_{\overline{80:90}} - 5A_{\overline{80:90}}$  to  $5A_{\overline{80:90}} - 4A_{\overline{80:90}}$

[3/21/2015] On page 1757, in the solution to question 8, on the second line, change  $v(kt)$  to  $v(t)^k$ .

[3/29/2016] On page 1758, in the solution to question 11, on the first line, change  $Y = \text{Var}(1.06Z)$  to  $Y = 1.06Z$ .

[4/20/2015] On page 1759, in the solution to question 15, 4 lines from the end, the expression  $\left(b + \frac{G - e}{d}\right)$  should be squared:  $\left(b + \frac{G - e}{d}\right)^2$ .

[4/29/2015] On page 1761, in the solution to question 21, on the first displayed line, change  ${}_{10|\ddot{a}}_x$  to  ${}_{10|\bar{a}}_x$ .

[12/3/2014] On page 1731, in the solution to question 2(a), on the second displayed line, change  $\mu_t^{00}$  to  $\mu_t^{10}$ . On the second and third displayed lines, change  $\mu_t^{02}$  to  $\mu_t^{12}$  once apiece on each line.

[12/4/2014] On page 1786, in the solution to question 2(c), on the first line, change  $1.04^2$  to  $1.04^2 - 1$ . On the second line, change  ${}_1p_0^{02}$  to  $({}_1p_0^{02} - 0.5p_0^{02})$ .

[12/3/2014] On page 1787, in the solution to question 3(d), on the second and second-to-last lines, once apiece, change "nubmer" to "number".

[12/3/2014] On page 1788, in the solution to question 4(d), replace the last two lines with

Actual number of deaths is 70, whereas pricing is  $10,000p_{45}q_{46} = 10,000(1 - 0.004)(0.00431) = 43$ . Higher mortality than pricing leads to a mortality loss.

[1/20/2015] On page 1800, in the solution to question 1(a), on the fourth displayed line, delete the expression between the two equals signs. Also, on the first and fourth displayed lines, change  $a_{36:\overline{9}}$  to  $a_{35:\overline{9}}$  in all three places.

[12/1/2014] On page 1801, in the solution to question 2(a), on the first line, add "average" between "Final" and "salary".

[5/1/2016] On page 1802, in the solution to question 3(c), replace the first line with

$$sq_{xy} = 1 - sp_x sp_y$$

[12/1/2014] On page 1804, in the solution to question 6(b), on the second displayed line, add "(1.05)" after "15,000(0.99)".

[2/12/2015] On page 1811, the lesson reference for Fall 2005 Question 35 should be 30 instead of 11.