

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

For Practice Exam 4:B2(c), make the correction for page 1489.  
 For Practice Exam 7:B4, make the correction for page 1520.  
 For Practice Exam 7:B6, make the correction for page 1521.  
 For Practice Exam 9:B4, make the correction for page 1540.  
 For Practice Exam 12:A10, make the correction for page 1564.  
 For Practice Exam 13:A9, make the correction for page 1575.

- [7/20/2020] On page 1, on the first line of the first bullet, change “emphsurvival” to “*survival*”.
- [7/20/2020] On page 99, in the solution to exercise 6.16, on the first line, change “between 21” to “between 20”.
- [7/20/2020] On page 104, on the last line of the solution to exercise 6.30, delete “ $o5 =$ ”.
- [7/6/2021] On page 175, exercise 10.10 belongs at the end of the exercises for Lesson 20.
- [1/4/2021] On page 178, in the solution to Quiz 10-1, on the last line, change  $2020 + 28 = \boxed{2048}$  to  $2020 + 29 = \boxed{2049}$ .
- [1/4/2021] On page 181, on the second line of the solution to Example 11B, change  $K_t$  to  $K_{t+1}$ .
- [6/28/2021] On page 183, 3 lines above Example 11D, replace the sentence beginning with “So the distribution” with  
 So the distribution of  $1 - \phi^m(x, t)$  has a mean that is 1 minus the mean of that lognormal and variance equal to the variance of that lognormal.
- [1/4/2021] On page 184, in Example 11E, question 3, change “ $q(50, 1)$  is greater than 0.007” to “ $q(50, 1)$  is less than 0.007”.
- [7/6/2021] On page 192, in the solution to exercise 11.3, on the second line, change  $-c + \sigma_k Z(11)$  to  $+c + \sigma_k Z_{11}$  and change  $0.01 Z_{11}$  to  $0.1 Z_{11}$ .
- [7/6/2021] On page 193, in the solution to exercise 11.10, on the last line of the page, change  $0.01 Z_{2017}^{(2)}$  to  $0.05 Z_{2017}^{(2)}$ .
- [6/28/2021] On page 194, in the solution to exercise 11.10, on the third line from the end, change  $lm(80, 2017)$  to  $lq(80, 2017)$ . Also change “the 5<sup>th</sup> percentile of  $p(85, 2017)$ ” to “the 95<sup>th</sup> percentile of  $p(80, 2017)$ ”.
- [7/6/2021] On page 194, in the solution to exercise 11.11(b), on the first line, change  $Z_{2019}^{(1)}$  to  $Z_{2019}^{(2)}$  in two places.
- [6/28/2021] On page 195, in the solution to exercise 11.13, replace all lines after “Subtract the third equation from this to eliminate  $K_{2020}^{(1)}$  with

$$\begin{aligned} -2K_{2020}^{(3)} &= -0.020243 \\ K_{2020}^{(3)} &= 0.010121 \\ K_{2020}^{(1)} &= -4.01946 + 142(0.010121) = -2.582232 \\ K_{2020}^{(2)} &= 4.18459 - 0.04 - 139(0.010121) - 2.582232 = 0.155484 \end{aligned}$$

Now we're ready to calculate  $q_{71}$  in 2020. The cohort factor for it is  $G_{2020-71} = -0.05$ .

$$\begin{aligned} lq(71, 2020) &= -2.582232 + 0.155494 + (1^2 - 140)(0.010121) - 0.05 = -3.88360 \\ q(71, 2020) &= \frac{e^{-3.88360}}{1 + e^{-3.88360}} = \boxed{0.020162} \end{aligned}$$

- [7/20/2020] On page 198, in exercise 12.6, change (i) to  $\mu_{x+t} = \alpha/(100 - (x + t))$ ,  $t \geq 0$ .
- [7/20/2020] On page 232, in the solution to exercise 13.18, split the last line into two, putting “Answer ...” on the second line.
- [7/20/2020] On page 308, in the solution to exercise 16.16, on the second line, change the exponent on  $\left(\frac{40-t}{40}\right)$  from 0.5 to 0.3.
- [2/15/2022] On page 315, in the solution to Example 17B, on the line for  $A_{35}$ , on the line for  $A_{35}$ , replace the numerator of the second fraction with  $(1 - 0.000195)(0.000205)$ .
- [7/21/2020] On page 472, in the solution to exercise 24.19, 4 lines before the end, change  $\ddot{a}_{67:\overline{2}|}$  to  $\ddot{a}_{67:\overline{3}|}$ .
- [7/21/2020] On page 516, in the solution to exercise 27.14, on the second line, change  $-0.2$  to  $-0.02$ . On the third line, change  $0.2$  to  $0.02$ .
- [6/16/2021] On page 551, in the solution to exercise 29.10, change the last line to

$$P = \frac{100,000(0.05413)}{12(7.7210)} = \boxed{58.4267}$$

- [7/21/2020] On page 603, on the first line of Example 33A, add “insurance” after “endowment”.
- [7/21/2020] On page 609, on the second-to-last line of exercise 33.17, add “insurance” after “endowment”.
- [6/19/2020] On page 643, in the solution to exercise 35.3, on the fifth line, change 2.236 to 2.326.
- [7/21/2020] On page 656, in the solution to exercise 36.15, on the last line, change **(AD)** to **(A)**.
- [7/21/2020] On page 721, in the solution to exercise 40.1, change the final answer from 0.000259 to 0.00259.
- [7/21/2020] On page 753, in exercise 41.60(b), on the second line, change “annual net premium” to “net level annual premium”.
- [7/21/2020] On page 766, in the solution to exercise 41.41, replace the last line with

$${}_{19}V = \frac{176.4470 + 5.288}{1.05} - 6.78 = \boxed{166.30}$$

- [7/21/2020] On page 784, in the solution to exercise 42.15, replace the last displayed line with

$${}_{15}V^{\text{mod}} = 235.24 - (7.0638)(4.5268) - (6.5586)(11.5331) = \boxed{127.62}$$

- [7/21/2020] On page 865, in exercise 47.1, all annuities should be continuous. Therefore the question should read  
A Markov chain has three states: Healthy (0), Sick (1), and Dead (2). Movement between states follows the Sickness-Death model and  $i = 0.05$ .

A 10-year deferred continuous whole life annuity on a healthy person age 55 pays 10,000 per year starting at age 65 as long as the annuitant is alive. Premiums are payable continuously for 10 years as long as the annuitant is healthy.

Calculate the annual net premium.

- [7/21/2020] On pages 876–87, in the solution to exercise 47.1, all annuities should be continuous. Replace every  $\ddot{a}$  with  $\bar{a}$ . There are six  $\ddot{a}$ s.
- [7/2/2021] On page 883, in the solution to exercise 47.22, on the last line, change  ${}_5V^{(1)}$  to  ${}_{10}V^{(1)}$ .
- [7/7/2021] On page 884, in the solution to exercise 47.25, on the first two displayed lines, change  $p_{x+t}^{03}$  and  $p_{x+t}^{13}$  to  $p_{x+5}^{03}$  and  $p_{x+5}^{13}$  respectively.

- [7/21/2020] On page 894, after the third line of the solution to Example 48E, add:  
 Reentry to state 2 is possible by first going to state 1 and then to state 0, so  $\bar{A}_{x+t}^{22}$ , the EPV of an insurance that pays 1 upon reentry to state 2, is not 0. However,  $\mu_{x+t}^{02} = 0$ , so this does not affect the final formula.  
 On the fourth line, change  $\mu_{x+t}^{02}(1 - \bar{A}_{x+t}^{02})$  to  $\mu_{x+t}^{02}(1 + \bar{A}_{x+t}^{22} - \bar{A}_{x+t}^{02})$ .
- [7/21/2020] On page 895, on the third line of Example 48F, change “if the accelerated death benefit was not used,” to “if the insured was never chronically ill;”.
- [7/7/2021] On page 903, exercise 48.3 is defective and should be skipped. It is inappropriate to use the claim acceleration method on annuities. It should only be used for insurance benefits, benefits paid upon a transition.
- [7/7/2021] On page 908, in exercise 48.12, the benefit of 20,000 at the end of the year of death from chronic illness is in lieu of the 100,000 death benefit paid if one dies from a healthy state. (This is an unusual accelerated death benefit).
- [7/7/2021] On page 913, exercise 48.23 is defective and should be skipped. The solution is incorrect, since it does not distinguish between an insurance that pays upon transition to state 3 regardless of the starting state of the transition and an insurance that pays upon transition to state 3 only if the transition starts in states 0 or 1.
- [8/23/2020] On page 916, make the following corrections to the solution to exercise 48.2:
- On the third and fourth lines of the page, change  $e^{-1.305}$  to  $e^{-1.2}$ .
  - On the fifth line, change 0.382728 to 0.425100 and change 0.125572 to 0.072607.
  - On the last line, change 0.125572 to 0.072607 and change the final answer to **12,857.56**.
- [7/7/2021] On page 917, in the solution to exercise 48.6, on the seventh and eighth lines, add “ $dt$  before the first equal sign on each line.
- [7/4/2021] On page 918, in the solution to exercise 48.11, on the second line, change  $(\bar{D}\bar{A})_{x:\overline{10}|}^{13}$  to  $(\bar{D}\bar{A})_{50+t:\overline{10}|}^{13}$ . Make the same change on line 6, and on lines 6–9, change all nine  $t$ s to  $u$ s. On line 7, add “ $du$ ” at the end of the line.
- [7/19/2020] On page 931, two lines below equation (49.6), change “ $t^{\text{th}}$  year” to “ $k^{\text{th}}$  year”.
- [7/21/2020] On page 982, in exercise 51.1, on the second line, change  ${}_4p_{50}^1$  to  ${}_4p_{50}^{(1)}$ . On the third line, change  ${}_4p_{50}^2$  to  ${}_4p_{50}^{(2)}$ . In exercise 51.2, on the fourth line, change  $p_x^2$  to  $p_x^{(2)}$ .
- [7/19/2020] On page 1003, in the solution to exercise 52.6, on the first line, change  ${}_3p_0^{(j)}$  to  ${}_2p_0^{(j)}$ .
- [7/21/2020] On page 1012, on the second line of the solution to Example 53D, replace the clause after the semicolon with  
 in the absence of decrement 1, 30% of the population at time 0 is decremented at time 1 by decrement 2.
- [7/21/2020] On page 1079, in the solution to exercise 57.16, on the second line, change  ${}_5p_{90:90}$  to  ${}_5q_{90:90}$ .
- [10/7/2021] On page 1093, on the last line of formula (58.9), change “ $n \geq a$  and  $b \leq a$ ” to the more general condition  $b \leq \min(a, n)$ .
- [7/21/2020] On page 1093, in exercise 58.16(ii), change  $i = 0.05$  to  $\mu = 0.05$ .
- [3/9/2021] On page 1110, in the solution to exercise 59.6, on the third line, change  $\mu_{x+t:y+t}^{01}$  to  $\mu_{x+t:y+t}^{02}$ .
- [6/22/2020] On page 1121, in exercise 60.23, on the first line, add “with” between “Markov chain” and “the”.

- [6/22/2020] On page 1141, in the solution to exercise 61.3, on the second line, add at the end of the sentence “if (y) dies first”.
- [7/22/2020] On page 1142, in the solution to exercise 61.8, on the first line, change  ${}_{10|10}q_{30:40}$  to  ${}_{10|10}q_{\overline{30:40}}$ .
- [10/7/2021] On page 1148, 3 lines from the bottom of the page, change the second “insurance” to “insurances”. On the next line, change 148.936 to 14,893.6 and 130,435 to 13,043.5. On the last line, change the final answer 5,151.89 to 4,495.84.
- [6/23/2020] On page 1170, in the solution to exercise 63.1, remove the comma after  $v^5$  on the first line. On the fifth line, change  $a_{30:40:\overline{10}}$  to  $a_{30:40:\overline{5}}$  and  ${}_{10}E_{30:40} a_{35:45}$  to  ${}_5E_{30:40} a_{35:45}$ .
- [6/26/2020] On page 1278, exercise 70.12 is missing answer choices. Add the following line at the end:
- (A) 10                      (B) 12                      (C) 15                      (D) 17                      (E) 18
- [7/22/2020] On page 1288, in the solution to exercise 70.25, on the first line, replace “eq:VarSnextrap” with “(68.6)”.
- [7/22/2020] On page 1293, on line 5 of the second paragraph, change “survival survivals” to “survival probabilities”.
- [7/22/2020] On page 1341, replace the solution to exercise 72.18 with

We need to calculate the probability of retirement at each age. From the wording of the retirement probabilities, we are given independent associated single decrements that happen one after the other. So we calculate probability of survivors to age 63, multiply that by 10% to get retiree count, subtract that, and then do the same at age 64. In the following table, all  $l_x$  and  $q_x$  are from the Standard Ultimate Life Table, and “non-retirement probability” is the probability of survival to the indicated age and not retiring at that age.

Age $x$	Survivorship probability ${}_{x-45}p_{45}^{(\tau)}$	Retirement probability ${}_{x-45}q_{45}^{(r)}$	Non-retirement probability
63	$\frac{l_{63}}{l_{45}} = \frac{95,534.4}{99,033.9}$ $= 0.964664$	$0.1(0.964664) = 0.096466$	$0.964664 - 0.096466 = 0.868197$
64	$0.868197p_{63} = 0.868197(1 - 0.004730)$ $= 0.864091$	$0.1(0.864091) = 0.086409$	$0.864091 - 0.086409 = 0.777682$
65	$0.777682p_{64} = 0.777682(1 - 0.005288)$ $= 0.773569$	$0.773569$	

The annual payment under the pension is  $(10)(0.02)(100,000) = 20,000$  before reduction for early retirement.

We use the values of  $\ddot{a}_x$ ,  $x = 63, 64, 65$  found in the Standard Ultimate Life Table for the retirement annuity values. The following table lists the factors we use:

Age	Reduction Factor	Retirement Probability	$\ddot{a}_x$	Discount Factor
63	0.8	0.086820	14.1151	$1/1.05^{18}$
64	0.9	0.077768	13.8363	$1/1.05^{19}$
65	1.0	0.773569	13.5498	$1/1.05^{20}$

The expected present value of the retirement benefit is

$$20,000 \left( \frac{(0.8)(0.096466)(14.1151)}{1.05^{18}} + \frac{(0.9)(0.086409)(13.8363)}{1.05^{19}} + \frac{(0.773569)(13.5498)}{1.05^{20}} \right) = \boxed{96,577.88}$$

[7/6/2020] On page 1352, on the second line after Table 71.1, delete “to” between “may” and “use”.

[7/22/2020] On page 1393, in exercise 71.3, replace (iii) with

The expected amount of money that the plan will pay during the year for exit benefits is 10,105.

[7/6/2020] On page 1354, in exercise 71.5, add the following statement after (v):

(vi) There are no exits from the pension plan within the first 10 years of service.

[7/9/2020] On page 1372, in the solution to exercise 74.5, on the third line, the fraction should be inverted; change  $\frac{1.04}{1.005(1.05)}$  to  $\frac{1.005(1.05)}{1.04}$ .

[7/22/2020] On page 1417, in exercise 77.7, change  $0.002k$  to  $0.002j$ .

[7/22/2020] On page 1489, in question 2(c), change 26 to 16.

[7/22/2020] On page 1507, in question 20(i), change “years” to “year”.

[7/22/2020] On page 1520, in question 4(b), on the third line, change “1.3” to “1.2”.

[7/22/2020] On page 1511, in question 6(b), delete “, using  $i=0.06$ ”. In question 6(f), change “It” to “it”.

[7/19/2020] On page 1528, in question B1 (iii), change 10,000,000 to 100,000.

[7/22/2020] On page 1540, in question 4(e), change “(c)” to “(d)”.

[6/23/2020] On page 1564, in question 10, on the second line from the end, change  ${}_0V = 2711.75$  to  ${}_0V = 0$ .

[7/22/2020] On page 1571, in the schematic diagram, change “4” in the Dead box to “3”.

[7/22/2020] On page 1575, in question 9, change the headings in the table from  $d_j, x_j, u_j$  to  $n_j, d_j, w_j$  respectively.

[9/18/2021] On page 1602, in the solution to question 2(b), change 174,349.35 to 177,686.10 on the last two lines, once apiece on each line. In the solution to question 2(c), on the last line, change 174,349.35 to 177,686.10 and change 11,325.02 to 11,450.14.

[7/22/2020] On page 1619, on the last line of the page, change “MLC” to “LTAM”.

[7/22/2020] On page 1625, in the solution to question 2(a), on the first line, change  $-26\ddot{a}_{55}$  to  $-16\ddot{a}_{55}$ . In the solution to question 2(b), change the last two lines to

$$258.2065 - 15.57760G = 0$$

so  $G = \boxed{16.5755}$ .

[7/22/2020] On page 1637, at the end of the solution to question 2(a), delete the stray “S”.

[7/22/2020] On page 1638, in the solution to question 3(b), change the last two lines to

$$1000(8.10782) + (x - 1000)(8.10782 - 7.9555) = 7955.5 + 0.1523x$$

The total EPV is  $14,321.1 + 2.7562x$ . Equating to 17,599.7, we get  $x = \boxed{1189.5}$ .

[7/22/2020] On page 1639, in the solution to question 4(c), remove the framed shaded box from 9.9409 and add the following line after that line:

$$10,000 {}_2\ddot{a}_{66} = \boxed{99,409}$$

[7/22/2020] On page 1660, replace the solution to question 19 with

We need to calculate the present value of exit benefits. Three times salary is 180,000.

$$\frac{180,000q_{40}}{(1+i)^{0.5}} = \frac{180,000(0.000527)}{1.05^{0.5}} = 92.57$$

The normal contribution is

$$62,537vp_{40} + 92.57 - 55,647 = 62,537\left(\frac{1-0.000527}{1.05}\right) + 92.57 - 55,647 = \boxed{3973} \quad (\mathbf{D})$$

[7/22/2020] On page 1664, replace the solution to question 6(b) with

The EPV at age 65 of the life annuity-due is  $137,315.6\ddot{a}_{65} = 137,315.6(13.5498) = 1,860,600$ . Discounting to age 35,

$$1,860,600 {}_{30}E_{35} = 1,358,999(0.61069)(0.35994) = \boxed{408,982}$$

[7/19/2020] On pages 1671–1672, replace the solution to question 1(b)–(c) with

- (b)  ${}_2p_{40}$  in Standard Ultimate Life Table is  $l_{42}/l_{40} = 99,229.8/99,338.3$ . In your table,  $\mu$  is 0.0001 lower, so

$${}_2p_{40} = \left(\frac{99,229.8}{99,338.3}\right)e^{0.0001(2)} = 0.999108$$

Select mortality is that probability raised to the 0.8, or  $0.999108^{0.8} = 0.999286$ . Working backwards from  $l_{42}$ , we get  $l_{[40]} = 99,448.3/0.999286 = \boxed{99,519.4}$ .

- (c) It's easier to work with annuity factors than directly with premium factors. Note that  $d = 1 - v = 0.05$ .

$$\ddot{a}_{[41]+1} = \frac{1}{P_{[41]+1} + d} = \frac{1}{0.003 + 0.05} = 18.86792$$

Do recursion to 43, then to 42, then to  $[40]+1$ .

$$P_{[41]+1} = (p_{42}^{\text{SULT}} e^{0.0005})^{0.8} = ((1 - 0.000608)e^{0.0001})^{0.8} = 0.999594$$

$$\ddot{a}_{43} = \frac{\ddot{a}_{[41]+1} - 1}{vp_{[41]+1}} = \frac{17.86792}{0.95(0.999594)} = 18.81599$$

$$p_{42} = p_{42}^{\text{SULT}} e^{0.0001} = (1 - 0.000608)e^{0.0001} = 0.999492$$

$$\ddot{a}_{42} = 1 + vp_{42}\ddot{a}_{43} = 1 + (0.95)(0.999492)(18.81599) = 18.86611$$

$$P_{[40]+1} = (p_{41}^{\text{SULT}} e^{0.0001})^{0.8} = ((1 - 0.000565)e^{0.0001})^{0.8} = 0.999628$$

$$\ddot{a}_{[40]+1} = 1 + (0.95)(0.999628)(18.86611) = 18.91613$$

$$P_{[40]+1} = \frac{1}{\ddot{a}_{[40]+1}} - d = \frac{1}{18.91613} - 0.05 = \boxed{0.002865}$$

[7/22/2020] On page 1674, in the solution to question 5(a) and 5(b), change 3195.1 to 319.51 in the two places it appears.

[7/22/2020] On page 1680, in the solution to question 14, replace the answer key **(D)** with **(C)**. Also correct the answer key on page 1677.

[7/22/2020] On page 1681, in the solution to question 17, replace the answer key **(E)** with **(B)**. Also correct the answer key on page 1677.

[7/22/2020] On page 1698, in the solution to question 6:

- In part (a), on the second displayed line, change 17,295.00 to 16,491.72.
- In part (c), on the third line from the end, change 0.03(120,178.6) to 0.03(20,178.6).
- Replace the solution to part (d) with  
As calculated in part (b), annual benefit accrual with projected career average is 2605.36. With 35 years of service, the annual pension is  $25(2605.36) = 65,134$ . Final salary is  $100,000(1.025^{19}) = 159,865$ . The replacement ratio is  $65,134/159,865 = \boxed{0.4074}$ .

[7/22/2020] On page 1702, in the solution to question 13, on the second and seventh lines, change 0.37135 to 0.36135.

[7/23/2020] On page 1704, in the solution to question 1(a), change the final answer to 65,685.58.

[7/23/2020] On page 1707, in the solution to question 4(c), change the last 3 lines to

$$\begin{aligned} &= 0.02e^{-0.5} \int_0^{10} t e^{-0.0075t^2} dt \\ &= -\frac{0.02e^{-0.5}}{0.015} e^{-0.0075t^2} \Big|_0^{10} \\ &= -\frac{0.02e^{-0.5}}{0.015} (e^{-0.75} - 1) = \boxed{0.426701} \end{aligned}$$

In the solution to question 4(d), on the last line, change 0.353206 to 0.426701 and change 0.360289 to 0.286794.

[7/23/1970] On page 1711, in the solution to question 4, on the second-to-last line, change  $e_{68}$  to  $e_{68}^2$ .

[7/23/2020] On page 1712, in the solution to question 9, change the answer key to (A). Also change the answer key on page 1710 accordingly.

[6/23/2020] On page 1712, in the solution to question 10, delete the second sentence “The initial reserve...”.

[7/23/2020] On page 1719, in the solution to question 6(c), on the second-to-last line, change 329.72 to 2329.72.

[7/23/2020] On page 1727, replace the last 3 lines of the solution to question 2(c) with

Linearly interpolating between  $l_{94}$  and  $l_{95}^-$ ,

$$\frac{25,094.3 - 24,834.6}{25,094.3 - 21,569.9} = 0.07369$$

The third quartile of survival time is  $\boxed{54.07369}$ .

[8/2/2020] On page 1731, replace the last 3 lines of the solution to question 6(c) with

$$e^{-0.06(16)} ({}_{16}p^{00} + {}_{16}p^{02}) = e^{-0.96} \left( e^{-0.72(16)} + \frac{3}{7}(e^{-0.02(16)} - e^{-0.72(16)}) \right) = 0.293089$$

The sum of these amounts multiplied by 100,000 is

$$100,000(0.025641 + 0.066364 + 0.293089) = \boxed{38,509.37}$$

[6/23/2020] On page 1869, replace the solution to question B6(c) with

$$NPV = \Pi_0 + \frac{\Pi_1}{1+r} + \sum_{k=2}^{\infty} \frac{\Pi_k}{(1+r)^k} = 8860$$

with  $\Pi_k$  being the  $k^{\text{th}}$  component of the profit signature.  $\Pi_k$  is the profit in year  $k$  per policy issued, while  $\text{Pr}_k$  is the profit per policy in year  $k$  per policy in force at the beginning of year  $k$ , so

$$\Pi_k = \begin{cases} \text{Pr}_k & k = 0, 1 \\ {}_{k-1}p_{65}^{(\tau)} \text{Pr}_k & k \geq 2 \end{cases}$$

so

$$\text{NPV} = \text{Pr}_0 + \frac{\text{Pr}_1}{1+r} + \sum_{k=2}^{\infty} {}_{k-1}p_{65}^{(\tau)} \frac{\text{Pr}_k}{(1+r)^k} = 8860$$

We want the second year profit  $\text{Pr}_2$  discounted with one year of interest, plus the third year profit discounted with one year of survivorship and two years of interest, and so on, or

$$\sum_{k=2}^{\infty} {}_{k-2}p_{66}^{(\tau)} \frac{\text{Pr}_k}{(1+r)^{k-1}}$$

Now,  ${}_{k-2}p_{66}^{(\tau)} = {}_{k-1}p_{65}^{(\tau)} / p_{65}^{(\tau)}$ .

Starting with NPV, we remove  $\text{Pr}_0$  and  $\text{Pr}_1/(1+r)$ . The remainder is multiplied by  $1+r$  and divided by  $p_{65}^{(\tau)}$ . We get

$$p_{65}^{(\tau)} = (1 - q_{65}^{(d)})(1 - q_{65}^{(w)}) = (1 - 0.005324)(1 - 0.03) = 0.964836$$

$$\text{Answer} = \left( 8860 - (-7500) - \frac{1095.95}{1.1} \right) \left( \frac{1.1}{0.964836} \right) = \boxed{17,515.98}$$