

## Errata and updates for ASM Exam 3L (Eighth Edition) sorted by page

- [7/2/2009] On page xii, on the last line of the page, change 0.8859 to 0.8860.
- [8/4/2009] On pages 5–6, in Section 1.3,  $\Pr(B) \neq 0$  and  $f(y) \neq 0$  are necessary for the definitions of conditional probability.
- [7/9/2009] On page 15, in the solution to exercise 1.14, on the 7th line, change  $g(x)$  to  $g(n)$ .
- [8/4/2009] On page 18, one line after Example 2A, add the word “independent”: “. . . from  $n$  independent identically distributed . . .”.
- [7/29/2009] On page 18, on the third line of Section 2.2, change “determines” to “determine”.
- [7/9/2009] On page 19, on the second displayed line, change 0.4889 to 0.5367.
- [1/24/2010] On page 27, in the solution to exercise 2.4, on the fourth line, change  $\text{Var}(mn)$  to  $\text{Var}(mN)$ .
- [8/31/2009] On page 30, in the solution to exercise 2.14, on the second line from the end, delete a plus sign between 0.0064 and 0.183125.
- [8/23/2009] On page 70, in the solution to question 4.22, on the second to last line, change 19.4470 to 19.4447.
- [8/14/2009] On page 81, in exercise 5.13, statement 2, change “form” to “from”.
- [8/14/2009] On page 109, on the last line of the solution to exercise 7.17, change the exponent 0.5314 to 0.05314.
- [8/24/2009] On page 126, in the solution to exercise 8.10, on the displayed line, replace 0.04540 with 0.00004540.
- [8/24/2009] On page 128, in the solution to exercise 8.29, on the last line, change 0.01 level to 0.10 level.
- [8/24/2009] On page 128, in the solution to exercise 8.30, replace the displayed line with

$$1 - \Phi\left(\frac{7 - 1}{\sqrt{12.5}}\right) = 1 - \Phi(1.697) = 0.045$$

- [8/20/2009] On page 138, on the line above the second displayed equation, put a bar on the second  $X$ .
- [8/24/2009] On page 144, in the solution to exercise 10.3, on the third line, change  $N\sqrt{2}$  to  $Z\sqrt{2}$ .
- [8/24/2008] On page 146, in the solution to exercise 10.16, on the third line, change 5th to 2.5th.
- [8/24/2009] On page 146, in the solution to exercise 10.18, on the second displayed line, change the denominator 1.3586 to 1.1656.
- [8/24/2009] On page 157, in the solution to exercise 11.5, on the last line, change the last numerator to  $(10 - 5)^2$ .
- [8/20/2009] On page 166, in the solution to exercise 12.8, while 3.33, 18.95, and 16.74 are not the exact percentiles of the  $\chi^2(9)$  distribution, if you divide 72 by the exact percentiles and round it to one decimal place, you get the corresponding numbers 21.6, 3.8, and 4.3 respectively.
- [8/25/2009] On page 166, in the solution to exercise 12.9, on the second displayed line, put a bar on  $X$ :  $\sum(X_i - \bar{X})^2$ .
- [8/25/2009] On page 170, on the 8th line of Section 13.2, change  $\sum \hat{\epsilon}_i y_i$  to  $\sum 2\hat{\epsilon}_i(\hat{Y}_i - \bar{Y})$ .
- [8/25/2009] On page 171, replace the displayed line one line above Section 13.3 with

$$R^2 = \frac{\sum(x_i y_i)^2}{(\sum x_i)^2 (\sum y_i)^2}$$

- [8/25/2009] On page 178, in exercise 13.21, on the first line, remove the hat in the subscript from  $\sigma_{\hat{\epsilon}}$ .

[8/25/2009] On page 183, in the solution to exercise 13.17, replace the last displayed line with

$$\sigma_{\hat{\beta}} = \frac{0.000379}{4.4102} = 0.00008588$$

[8/25/2009] On page 184, in the solution to exercise 13.25, on the first line, change  $\sum Y_i - \bar{Y}$  to  $\sum(Y_i - \bar{Y})^2$ .

[8/25/2009] On page 184, in the solution to exercise 13.29, on the last line, the denominator should be  $216.680 + 91.321$ ; change the minus sign to a plus sign.

[6/11/2009] On page 214, in the solution to exercise 17.6, on the third line, replace David with Dick.

[7/13/2009] On page 215, in the solution to exercise 17.8, on the displayed line, change the subscript  $x + t$  to  $x + 5$ .

[7/13/2009] On page 216, in the solution to exercise 17.9, replace 0.948574 with 0.948514 on the third from last line and the last line.

[8/31/2009] On page 218, replace the paragraph in the answer to part 3 of Example 4A with

This can be evaluated as  ${}_{10}p_{40} - {}_{30}p_{40}$  or as  ${}_{10}p_{40} {}_{20}q_{50}$ ; either way, we need two integrals to evaluate this. We'll use the former expression. We already saw in the previous two solutions that for this force of mortality,  ${}_t p_x = (65 + x)/(65 + x + t)$ .

[7/12/2009] On page 222, in Table 18.1, on the second to last line, replace  ${}_t p_x e^k$  with  ${}_t p_x e^{-kt}$ . On the last line, replace  $\mu x(t)$  with  $\mu_x(t)$  and "for all  $k$ " with "for all  $t$ ".

[8/31/2009] On page 226, in exercise 18.22, on the third line, change  $q_x$  to  $q_{30}$ .

[8/24/2009] On page 232, in the solution to exercise 18.15 part 2, put  $dx$  after the integrand  $0.05(1.01)^x$ .

[8/2/2009] On page 236, in the solution to exercise 18.35, put a negative sign before the integral in the first and second displayed lines.

[1/24/2010] On page 240, on the second line of the answer to Example 19A, change  $\omega = 70$  to  $\omega - x = 70$ .

[8/31/2009] On page 259, in the solution to exercise 20.1, replace "negative the exponentiated integral" with "the exponential of the negative integral".

[7/14/2009] On page 283, in the solution to exercise 21.25, on the third line from the end, change  $+\frac{0.6931}{2}$  to  $-\frac{0.6931}{2}$ .

[9/3/2009] On page 291, in Table 22.1, on the sixth row under "Constant force of mortality", put a minus sign before  $(p_x^s)$ .

[7/2/2009] On page 300, in the solution to exercise 22.12, on the second line from the end, change  $1 - 0.5(0.6)$  to  $1 - 0.5(0.06)$ .

[9/3/2009] On page 300, in the solution to exercise 22.13, 4 lines from the end, delete one of the 1's after "are".

[9/3/2009] On page 300, in the solution to exercise 22.14, on the last line of the page, the left hand side should be  $\mathbf{E}[T^2 \wedge 2]$ .

[7/14/2009] On page 301, in the solution to exercise 22.15, the page reference should be page 289, not page 22.8.

[7/14/2009] On page 302, in the solution to exercise 22.19, on the fourth displayed line,  $\frac{5}{24}$  should be  $-\frac{5}{24}$ .

[7/7/2009] On page 302, in the graph for the solution to exercise 22.20, change  $l_x$  to  ${}_{x-20}p_{20}$ .

[7/2/2009] On pages 307–349, change "actuarial present value" to "present value" in:

- Section 23.1, third paragraph, third sentence.

- Example 23D, the sentence starting “Let  $Z$  be”.
- Example 23D answer, second sentence.
- Example 23F, the sentence starting “ $Z$  is”.
- Solution to exercise 24.22, first sentence.
- Solution to exercise 24.23, first sentence.

[7/16/2009] On page 309, 4–5 lines from the bottom, add  $dt$  after the integral and delete the line with  $ddt$ .

[7/16/2009] On page 311, 3 lines from the bottom, change “prsent” to “present”.

[2/24/2010] On pages 312–313, replace the last three lines of page 312 and the first three lines of page 313 with  
For the deferred insurance, we will use formula

$$\bar{A}_x = {}_x E_x A_{x+n}$$

First we calculate the 5-year pure endowment at  $\delta$  and  $2\delta$ ;  $\mu = 0.01$  in this period.

$${}_5 E_x = e^{-5(0.01+0.06)} = 0.704688$$

$${}_5^2 E_x = e^{-5(0.01+0.12)} = 0.522046$$

Then we calculate  $A_{x+5}$  at  $\delta$  and  $2\delta$ ;  $\mu = 0.02$  in this period.

$$\bar{A}_{x+5} = \frac{\mu}{\mu + \delta} = \frac{0.02}{0.02 + 0.06} = 0.25$$

$${}^2\bar{A}_{x+5} = \frac{\mu}{\mu + 2\delta} = \frac{0.02}{0.02 + 0.12} = \frac{1}{7}$$

[9/25/2009] On page 314, in the answer to Example 23F, on the second displayed line, change the first exponent to  $-[0.01 + 2(0.03)](10)$

[7/16/2009] On page 323, in the solution to exercise 23.5, on the first line, change  $\bar{A}_{x+t}$  to  $\bar{A}_{x+3}$ .

[8/8/2009] On page 323, in the solution to exercise 23.7, the proof is inadequate, since it is not given that force of mortality is constant. Replace the passage after **(B)** to the end of the solution with

To prove the inequalities:

First consider adding a constant to  $\delta$ . Since  $\bar{A}_x = \mathbf{E}[v^T]$ ,  $\bar{A}_x'' = \mathbf{E}[v^T e^{-cT}]$ . For any two functions  $g_1(t)$  and  $g_2(t)$  of a random variable  $T$ , if  $g_1(t) < g_2(t)$  always, then  $\mathbf{E}[g_1(t)] < \mathbf{E}[g_2(t)]$ . Here,  $g_1(t) = e^{-ct} v^t$  and  $g_2(t) = v^t$ , and  $g_1(t) < g_2(t)$  since  $e^{-ct} < 1$ . So  $\mathbf{E}[v^T e^{-cT}] < \mathbf{E}[v^T]$  and we have proved that  $\bar{A}_x'' < \bar{A}_x$ .

Now consider adding a constant to  $\mu$ . For  $\bar{a}_x$ , adding a constant to  $\mu$  results in a lower value, since  $\bar{a}_x = \int_0^\infty v^t {}_t p_x dt$ , and adding a constant to  $\mu$  lowers  ${}_t p_x$ . However,  $\bar{A}_x = 1 - \delta \bar{a}_x$ , so making  $\bar{a}_x$  higher results in making  $\bar{A}_x$  lower.

[7/16/2009] On page 323, in the solution to exercise 23.8, on the second line, change  $e^{-1.6}$  to  $100,000e^{-1.6}$ .

[9/9/2009] On pages 324–325, the solution to exercise 23.13 should use continuously compounded rates of benefit growth rather than effective rates. The revised solution is:

Let  $A$  be the single benefit premium. The continuous rate of increase offsets the interest, so in effect we have  $\delta = -0.04$  in the first 10 years and  $\delta = 0.01$  thereafter. Then

$$\bar{A} = \frac{0.05}{0.05 - 0.04} (1 - e^{-0.01(10)}) + e^{-0.01(10)} \frac{0.05}{0.05 + 0.01} = \boxed{1.2298} \quad (\text{A})$$

[7/16/2009] On page 327, in the solution to exercise 23.27, on the last line, remove the second of the three minus signs;  $(7/3)^2$  should be multiplied by the parenthesized expression.

[1/21/2010] On page 342, in the solution to exercise 24.5, on the second line, delete  $\int_0^{60} e^{-0.06t} dt$ . On the fourth line, change “interest rate” to “force of interest”.

[1/21/2010] On page 343, in the solution to exercise 24.9, replace  $\bar{a}_{\overline{75}|}$  with  $\bar{a}_{\overline{25}|}$  on the first and fourth displayed lines.

[7/17/2009] On page 344, in the solution to exercise 24.15, on the 5th displayed line, change  $\frac{4}{15}$  to  $\frac{4}{14}$ .

[7/17/2009] On page 359 in the solution to exercise 25.3, on the 6th line, replace the second sentence with  
 We want  $\Pr(1.864707e^{-0.06T} > 0.5)$ , or  $\Pr(e^{-0.06T} > 0.5/1.864707)$  and  $0.5/1.864707 = 0.268139$ , or  $\Pr(T < -\ln 0.268139/0.06)$ , and  $-\ln 0.268139/0.06 = 21.9375$ .

[9/9/2009] On page 360, in the solution to exercise 25.9, on the first line, replace  $\lambda$  with  $\delta$ .

[9/9/2009] On page 380, in exercise 26.36, on the second line after the table, add “age 49” at the end of the sentence after “100 lives”.

[7/19/2009] On page 389, in the solution to exercise 26.34, on the second line from the end, change 0.21546 to 0.021546.

[7/20/2009] On page 392, change the third sentence of Section 27.2 to

The symbols for the actuarial present values for the functions paying at the end of the year of death are the same as for the functions paying at the moment of death, except there is no bar on the  $A$ .

[7/27/2009] On page 406, in the solution to exercise 27.22, on the first line, change  $vq_{50}$  to  $1000vq_{50}$ .

[2/21/2010] On page 411, on the first line, replace  $a_{\overline{T}|}$  with  $\bar{a}_{\overline{T}|}$ .

[9/15/2009] On page 421, in the solution to exercise 28.7, on the 6th line, replace  $0.09 + 0.3 = 0.09$  with  $0.09 + 0.03 = 0.12$ .

[9/9/2009] On page 447, in the solution to exercise 29.14, the last line should read

$$ia_{x:\overline{n}|} + (1+i)A_{x:\overline{n}|} - 1 = 1 + i - i + i_n E_x - 1 = \boxed{i_n E_x} \quad (\mathbf{B})$$

[7/24/2009] On page 455, in equation (30.6), replace  $\ddot{a}_{\overline{T(x)}|}$  with  $\ddot{a}_{\overline{K(x)+1}|}$ .

[7/26/2009] On page 456, on the 12th line under “Variance of a deferred annuity”, replace  $\text{Var}(Y | I)$  with  $\text{Var}_I(\mathbf{E}[Y | I])$ .

[8/6/2009] On page 458, on the last line of the page,  $(-1266.67^2)$  should be  $(-1266.67)^2$ .

[7/24/2009] On page 461, in exercise 30.6, change “continous” to “continuous whole”

[11/18/2009] On page 466, in the solution to exercise 30.1, in the second bullet, change  $E[T(x)]^2$  to  $\mathbf{E}[T(x)^2]$ .

[9/9/2009] On page 466, in the solution to exercise 30.2, on the second displayed line, move the double-dot off the E to  $a_{x:\overline{30}|}$ .

[9/9/2009] On page 468, in the solution to exercise 30.9, on the fourth line, change  ${}_tq_{30}$  to  ${}_t|q_{30}$ .

[9/15/2009] On page 477, on the last line (twice), and on page 478, line 6, replace  $\bar{a}_{x:\overline{n}|}$  with  $\bar{a}_{\overline{n}|}$ .

[7/17/2009] On page 479, in Example 31A(ii), change  $\frac{60-x}{x}$  to  $\frac{60-t}{60}$ .

[8/6/2009] On page 490, in the solution to exercise 31.6, on the last line, remove the minus sign from the exponent.

[12/5/2009] On page 492, in the solution to exercise 31.14, on the 6th displayed line, change  $t$  to  $T$ .

- [7/26/2009] On page 493, in the solution to exercise 31.16, on the second displayed line,  $e^{-0.02(20)}$  should be  $e^{-0.02(20)}$ .  
 On the 7th displayed line,  $e^{-1.2}(0.08)$  should be  $\frac{e^{-1.2}}{0.08}$ .
- [9/15/2009] On page 497, in the solution to exercise 31.32, on the last line, replace  $u(65)$  with  $u(64)$ .
- [12/30/2009] On page 505, exercise 32.16 requires the formula relating insurances paid at the end of the year of death to those paid at the moment of death, which is not on the CAS syllabus, so skip the exercise.
- [9/23/2009] On page 515, in exercise 33.3, on the first line, change fully to fully.
- [7/28/2009] On page 530, in the solution to exercise 33.1, on the first displayed line, change  ${}_{k-1}q_0$  to  ${}_{k-1|}q_0$ . On the third displayed line, change 0.5 to 0.05.
- [7/28/2009] On page 531, in the solution to exercise 33.3, on the first displayed line, change the  $t$ 's to  $k$ 's:

$$A = \sum_{k=1}^3 b_k q_{x+k-1} v^k$$

In the fourth displayed equation, change  $px$  to  $p_x$ .

- [7/28/2009] On page 533, in the solution to exercise 33.7, on the last line, the denominator should be 14, not 13.236242.
- [7/28/2009] On page 533, in the solution to exercise 33.9, on the third displayed line, the denominator should be  $40(0.05)$  instead of 40.
- [9/23/2009] On page 538, in the solution to exercise 33.25, on the 6th and 8th lines, put double-dots on the three  $a$ 's that don't have them.
- [11/18/2009] On page 544, in the solution to exercise 33.47, on the first line of the page, change  $\frac{1}{\ddot{a}_{20}}$  to  $\ddot{a}_{20}$ .

- [7/28/2009] On page 544, replace the last line of the solution to exercise 33.49 with

$$1000 \left( \frac{dA'_{60}}{1 - A'_{60}} \right) = 1000 \left( \frac{0.06(0.36986)}{1.06(1 - 0.36986)} \right) = \boxed{33.22}$$

- [7/31/2009] On page 547, on the last line of Example 34A, delete the word "benefit".
- [8/2/2009] On page 551, the solution to exercise 34.7 should read

$$1000A_{25} - \pi_b \ddot{a}_{25} = 1000(0.259800) - 31.1857 \left( \frac{(1 - 0.259800)(1.05)}{0.05} \right) = \boxed{-224.96}$$

- [8/2/2009] On page 563, in the solution to exercise 35.16, on the fifth line from the end, change " $v^T$  otherwise" to " $v^n$  otherwise".
- [7/29/2009] On page 572, in the solution to exercise 36.7, on the fourth displayed line, the line should end with 1.7763, and  $\frac{P}{d} = 0.7763$  should be placed a separate line.
- [9/23/2009] On page 573, in the solution to exercise 36.11, replace the third displayed line with

$$\Pr(S > 45) = \Pr \left( \frac{S - 33}{\sqrt{36}} > \frac{45 - 33}{\sqrt{36}} \right) = \Pr \left( \frac{S - 33}{6} > 2 \right)$$

- [8/3/2009] On page 577, on the fourth line of the second paragraph, delete the word "benefit".

- [9/23/2009] On page 579, in the answer to Example 37C part 2 two lines from the end, change  ${}_{15}^{20}V_x$  to  ${}_{15}^{20}V_{40}$ .
- [8/3/2009] On page 588, in the solution to exercise 37.12, on the 4th displayed line, change 0.46587 to 0.046587.
- [8/3/2009] On page 604, in the solution to exercise 38.13, on the 4th line, change  $\overset{(2)}{V}$  to  ${}_tV^{(2)}$ .
- [2/10/2010] On page 606, in the solution to exercise 38.19, on the second to last line, change  $\bar{a}_{50:\overline{10}|}$  to  $\bar{a}_{50:\overline{7}|}$ .
- [8/4/2009] On page 618, in the solution to exercise 39.1, on the third displayed line, change  ${}_{10}V_{50:\overline{20}|}^1$  to  ${}_{10}V_{50:\overline{20}|}^1$ .
- [8/4/2009] On page 619, in the solution to exercise 39.6, on the displayed line, change the  ${}_t\bar{V}(\bar{A}_{x+t})$  to  ${}_t\bar{V}(\bar{A}_x)$
- [2/10/2010] On page 620, in the solution to exercise 39.14, on the third displayed line, change  $B$  to  $\frac{B}{1000}$ .
- [8/4/2009] On page 622, in the solution to exercise 39.20, on the last line, change  ${}_{20}V_{35}$  to  ${}_{20}V_{25}$ .
- [8/4/2009] On page 622, in the solution to exercise 39.21, on the second line from the end, change  $1 - 0.1(0.4)$  to  $1 - 0.1(4)$ .
- [9/23/2009] On page 624, in the solution to exercise 39.27, on the first displayed line, change  $P_x$  to  $P_{36}$ .
- [8/4/2009] On page 624, in the solution to exercise 39.29, on the fifth line, “five ratios” should be two words.
- [10/27/2009] On page 627, in the first displayed formula, replace  $\text{Var}({}_tL | T(x) \geq t)$  with  $\text{Var}({}_tL | T(x) > t)$ .
- [8/5/2009] On page 653, in the solution to exercise 41.16, on the third line from the end,  $1.05^{16}$  should be in the numerator, so that the right hand side is

$$\frac{107.1389(1.05^{16})}{0.044135}$$

- [8/5/2009] On page 653, in the solution to exercise 41.18, on the first displayed line, change  $A_{x+20}$  to  $1000A_{x+20}$ .
- [8/15/2009] On page 660, two lines below the 4th displayed equation, change  $s_{T(x),T(y)}(t)$  to  $s_{T(x),T(y)}(t, t)$ .
- [8/12/2009] On page 662, in equation (42.2), change the last  ${}_tq_{xy}$  to  ${}_tq_x {}_tq_y$ .
- [3/1/2010] On page 670, in the solution to exercise 42.5, on the first two displayed lines, remove the line in the presubscripts of  $p_{xy}$ .
- [11/18/2009] On page 676, on the 11th line, change “to age  $x + t$ ” to “to ages  $x + t$  and  $y + t$ ”.
- [11/18/2009] On page 677, in the solution to Example 43B, the values of  ${}_tp_{80}$  and  ${}_tp_{82}$  for  $t = 2$  and  $t = 3$  are interchanged on the 2nd, 3rd, 8th, and 10th lines of the answer.
- [9/23/2009] On page 678, in Table 43.1, three minus signs are missing: on the first line,  $\mu_s(t) = -(\text{d}_t p_s / \text{d}t) \div {}_t p_s$ . On the second line and fourth lines, put a minus before the right hand sign. On the first, second, fourth, and eight lines, remove  $\ln$  from the numerator  $\text{d} \ln {}_t p_{\overline{xy}}$ .
- [3/8/2010] On page 688, in the solution to exercise 43.19, on the second displayed line, change the upper bound of the integral from 2 to 3.
- [8/12/2009] On page 689, in the solution to Quiz 43-2, the last line should be

$$\mu_{\overline{60:60}}(10) = \frac{2(1 - e^{-0.1})e^{-0.1}(0.01)}{2e^{-0.1} - e^{-0.2}} = \frac{0.0017221}{0.990944} = \boxed{0.001738}$$

- [2/17/2010] On page 692, two lines below equation (44.3), change the + to a -:

$$= \dot{e}_x + \frac{2}{3}\ddot{e}_x^2 \mu_y$$

- [11/18/2009] On page 695, in the answer to Example 44E, on the first displayed line, the integrand on the left is missing a  $t$  and should be  $t {}_t p_{40:40} dt$ .
- [9/23/2009] On page 700, in the solution to exercise 44.11, change all eleven  $x$ 's to  $t$ 's.
- [10/6/2009] On page 703, in the solution to exercise 44.21, on the sixth line, delete "integral of the". Three lines from the end, add "du" after " $dt = 5/\sqrt{u}$ ".
- [7/2/2009] On page 706, on the second to last line of Example 45B, delete the word "actuarial".
- [10/6/2009] On page 714, in the solution to exercise 45.10, on the second line, put a bar over  $A_{\overline{xy}}$ .
- [10/6/2009] On page 716, in the solution to exercise 45.19, on the fourth displayed line, the bar over 1 should be over  $P$ .
- [3/8/2010] On page 717, in the solution to exercise 45.20, on the second displayed line, delete "1 - " on the right hand side.
- [8/21/2009] On page 717, the solution to Quiz 45-1 is incorrect. The correct solution is  
We calculate the two single-life endowment insurances and the joint-life endowment insurance, the latter using  $\mu_{xy}(t) = 0.03$ .

$$\begin{aligned}\bar{A}_{x:\overline{10}|} &= \left(\frac{0.01}{0.01 + 0.06}\right)(1 - e^{-0.7}) + e^{-0.7} = 0.568502 \\ \bar{A}_{y:\overline{10}|} &= \left(\frac{0.02}{0.02 + 0.06}\right)(1 - e^{-0.8}) + e^{-0.8} = 0.586997 \\ \bar{A}_{xy:\overline{10}|} &= \left(\frac{0.03}{0.03 + 0.06}\right)(1 - e^{-0.9}) + e^{-0.9} = 0.604380 \\ \bar{A}_{\overline{xy}:\overline{10}|} &= 0.568502 + 0.586997 - 0.604380 = 0.55112\end{aligned}$$

The single benefit premium is **551.12**.

- [9/25/2009] On page 719, in the answer to Example 46A, on the 6th line, replace  ${}_2q_x$  with  ${}_3q_x$ .
- [11/18/2009] On page 720, in the answer to Example 46B, on the third line, change "an joint-life" to "a joint-life".
- [10/6/2009] On page 723, in the answer to Example 46E, on the third line from the end, replace  ${}_{5|15}\bar{a}_{55}$  with  ${}_{5|10}\bar{a}_{40:55}$ . On the next line, replace the last  ${}_{5|15}\bar{a}_{55}$  with  ${}_{5|10}\bar{a}_{40:55}$ .
- [10/6/2009] On page 723, on the second line of Example 46F, delete the apostrophe before (65).
- [10/6/2009] On page 739, in the solution to exercise 46.21, three lines from the end, replace the subscript  $\overline{y : \bar{y} : \bar{n}}$  with  $\overline{y : \bar{y} : \overline{10}}$ .
- [9/25/2009] On page 740, in the solution to exercise 46.23, on the second line of the page,  ${}_{30}E_{20}$  should be  ${}_{30}E_{20}$ .
- [8/18/2009] On page 741, the last 4 lines of the solution to Quiz 46-2 are incorrect. Replace them with:

$$\begin{aligned}\ddot{a}_{45:55:\overline{30}|} &= \ddot{a}_{45:55} + \ddot{a}_{45:\overline{30}|} - \ddot{a}_{45:55:\overline{30}|} \\ &= \ddot{a}_{45:55} + \ddot{a}_{45} - {}_{30}E_{45} \ddot{a}_{75} - \ddot{a}_{45:55} + {}_{30}E_{45:55} \ddot{a}_{75:85} \\ {}_{30}E_{45:55} &= {}_{30}E_{45} \left(\frac{l_{85}}{l_{55}}\right) = (0.10252) \left(\frac{2,358,246}{8,640,861}\right) = 0.02798 \\ \ddot{a}_{45:55:\overline{30}|} &= 14.1121 - (0.10252)(7.2170) + (0.02798)(3.9099) = 13.4816 \\ 100\ddot{a}_{45|\overline{55}:\overline{30}|} &= 100(14.8140 - 13.4816) = \mathbf{133.24}\end{aligned}$$

[10/6/2009] On page 744, in Section 47.2, in the third and fourth displayed equations, change the subscripts on the  $d$ 's from  $x + k + 1$  to  $x + k$ .

[8/19/2009] On page 745, the calculation of  $\text{Var}(Y_1)$  and  $\text{Var}(Y_2)$  in the solution to exercise 37.25 is incorrect. The correct solution is

Let  $Y_1$  be the present value random variable for an annuity of 1 on the joint status and  $Y_2$  the present value random variable for an annuity of 1 on the last survivor status. Then  $Y = 10(Y_2 - Y_1)$ , so

$$\text{Var}(Y) = 100 \text{Var}(Y_2) + 100 \text{Var}(Y_1) - 200 \text{Cov}(Y_1, Y_2)$$

Let's calculate these moments.

$$\begin{aligned}\bar{A}_x &= \frac{0.005}{0.005 + 0.05} = 0.090909 \\ \bar{A}_y &= \frac{0.025}{0.025 + 0.05} = 0.333333 \\ \bar{A}_{xy} &= \frac{0.03}{0.03 + 0.05} = 0.375 \\ \bar{A}_{\overline{xy}} &= 0.090909 + 0.333333 - 0.375 = 0.049242 \\ {}^2\bar{A}_x &= \frac{0.005}{0.005 + 0.1} = 0.047619 \\ {}^2\bar{A}_y &= \frac{0.025}{0.025 + 0.1} = 0.2 \\ {}^2\bar{A}_{xy} &= \frac{0.03}{0.03 + 0.1} = 0.230769 \\ {}^2\bar{A}_{\overline{xy}} &= 0.047619 + 0.2 - 0.230769 = 0.016850 \\ \text{Var}(Y_1) &= \frac{0.230769 - 0.375^2}{0.05^2} = 36.05769 \\ \text{Var}(Y_2) &= \frac{0.016850 - 0.049242^2}{0.05^2} = 5.77000 \\ \text{Cov}(Y_1, Y_2) &= \frac{(0.090909 - 0.375)(0.333333 - 0.375)}{0.05^2} = 4.73489 \\ \text{Var}(Y) &= 100(36.05769) + 100(5.77000) - 200(4.73489) = \boxed{3235.79}\end{aligned}$$

[10/4/2009] On page 752, in exercise 47.13(ii), replace  $c = 0, 1, 2$  with  $k = 0, 1, 2$ .

[3/1/2010] On page 754, exercise 47.20, change (iii) to

The probability that an entering student fails in the first year is twice the probability that a student who completed the first year fails in the second year.

[10/6/2009] On page 760, in the solution to exercise 47.20, on the first line, replace "voluntarily" with "leaving voluntarily in the second year".

[11/18/2009] On page 765, in the answer to Example 48C, 3 lines from the end in the integrand, change  ${}_{10}P_x^{(\tau)}$  to  ${}_tP_x^{(\tau)}$

[3/8/2010] On pages 773–774, in the solution to exercise 48.3, on the first displayed line (page 773) and the first line of page 774, replace  $\mu_c^{(2)}(20)$  with  $\mu_{40}^{(2)}(20)$ .

[3/8/2010] On page 774, in the solution to exercise 48.4, replace  $\mu_{20}^{(\tau)}$  with  $\mu_{40}^{(\tau)}(20)$  and  $\mu^{(2)}$  with  $\mu_{40}^{(2)}(20)$ .

[10/6/2009] On page 775, in the solution to exercise 48.13, eight lines from the bottom of the page, put a "5" before  ${}_tP_x^{(\tau)}$ .

- [10/6/2009] On page 777, in the solution to exercise 48.22, two lines from the bottom of the page, change  $e^{-\mu^{(r)}}$  to  $e^{-t\mu^{(r)}}$ .
- [10/6/2009] On page 779, in the solution to exercise 48.27, three lines from the end, delete the equals sign at the beginning of the line.
- [10/6/2009] On page 785, on the second line from the end of the first paragraph, change  ${}_kQ^{(i,i)}$  to  ${}_kQ^{(i,j)}$ .
- [8/14/2009] On pages 811–812, in the solution to exercise 50.9, change 0.04608 to 0.4608 on the line “No payment” and on the first white line of the table on page 812.
- [11/18/2009] On page 815, 9 lines from the bottom of the page, change “variables” to “variable”.
- [11/18/2009] On page 816, on the fourth line of the answer to Example 51B, change “number” to “numbers”.
- [11/18/2009] On page 819, the caption of Figure 51.1 should refer to Example 51H instead of 51G.
- [8/16/2009] On page 827, in the first sentence, change the phrase between dashes to “the time from when  $N(t) = 0$  until  $N(t) = n$ ”.
- [10/12/2009] On page 827, on the first line of the answer to Example 52A, change  $t \geq 4$  to  $T \geq 4$ .
- [11/18/2009] On page 827, on the second line from the bottom of the page, add “ $du$ ” at the end.
- [8/16/2009] On page 832, in the solution to Quiz 52-2, on the first displayed line, change 0.0108 to  $\frac{1}{0.0108}$ .
- [8/16/2009] On page 833, in the solution to Example 53A, change the final answer from 0.04656 to 0.04653.
- [11/18/2009] On page 724, 3 lines before Section 46.4, change the first minus sign to an equals sign:

$$= {}_{10}E_{55}(a_{65} - a_{65:65})$$

- [10/12/2009] On page 845, in the second sentence of the paragraph before Example 54B, change “If X if” to “If X is”.
- [11/18/2009] On page 848, in the answer to Example 54E part 2, in the second sentence of the first bullet, change  $r$  to  $\theta$ .
- [9/29/2009] On page 852, in the solution to exercise 54.4, on the fourth line, delete the word “twice”.
- [8/17/2009] On page 854, in the solution to exercise 54.14, on the third line, change  $0.7\lambda$  to 0.7 (delete  $\lambda$ ).
- [10/12/2009] On page 861, in question 55.12, on the first line, change  $X_n$  to  $X_N$ .
- [10/12/2009] On page 867, in the solution to question 55.8, on the displayed line, change  $\mathbf{E}[X | I]$  to  $\mathbf{E}[S | I]$ .
- [8/17/2009] On page 867, in the solution to exercise 55.10, on the last line, change 07422 to 0.7422.
- [10/20/2009] On page 910, in question 21, replace the second line with

$$\mathbf{Q}_0 = \begin{pmatrix} 0.8 & 0.2 \\ 0.4 & 0.6 \end{pmatrix} \quad {}_2\mathbf{Q}_0 = \begin{pmatrix} 0.38 & 0.62 \\ 0.44 & 0.56 \end{pmatrix}$$

- [11/5/2009] On page 939, in the solution to question 3, on the first line, change  $\mu_{x+t}$  to  $\mu_t$ .
- [11/5/2009] On page 940.08, in the solution to question 8, on the line with (\*\*), the left hand side should be  $a_{x:\overline{10-x}|} + A_{x:\overline{10-x}|}$ . On the second line from the end, the left hand side should be  $a_{x:\overline{10-x}|}$ .
- [11/5/2009] On page 940, in the solution to question 10, on the first line of the table,  $q_{x+t}$  should be  $q_{x+t-1}$ .
- [10/20/2009] On page 960, in the solution to question 22, on the fourth line, replace  $\sqrt{3,335,337} \left( \frac{1}{130} + \frac{1}{80} \right)$  with  $\sqrt{3,335,337 \left( \frac{1}{130} + \frac{1}{80} \right)}$ .

[10/20/2009] On page 968, the solution to question 21 is incorrect. The correct solution is

Let  $\mathbf{Q}_1 = \begin{pmatrix} x & 1-x \\ y & 1-y \end{pmatrix}$ . Since  $\mathbf{Q}_0 \mathbf{Q}_1 = {}_2\mathbf{Q}_0$ ,

$$\begin{pmatrix} 0.8 & 0.2 \\ 0.4 & 0.6 \end{pmatrix} \begin{pmatrix} x & 1-x \\ y & 1-y \end{pmatrix} = \begin{pmatrix} 0.38 & 0.62 \\ 0.44 & 0.56 \end{pmatrix}$$

Equating the left column vectors of both sides, we have

$$0.8x + 0.2y = 0.38$$

$$0.4x + 0.6y = 0.44$$

Doubling the second equation and subtracting the first from it, we get  $y = 0.5$ ,  $x = 0.35$ . From  ${}_2\mathbf{Q}_0$ , we see that the state vector after two transitions for someone in state 1 is  $(0.38, 0.62)$ . Then the probability of being in state 2 after another transition is  $0.38(1-x) + 0.62(1-y) = 0.38(0.65) + 0.62(0.5) = \boxed{0.557}$ . (E)

[11/5/2009] On page 973, in the solution to question 10, on the sixth displayed line, add  $dy$  at the end.

[11/5/2009] On page 984, in the solution to question 19, on the sixth displayed line, change the  $=$  in the exponent to a  $-$ .

[9/7/2009] On page 985, in the solution to question 23, on the last line, put a bar on  $P$ .

[8/19/2009] On page 987, in the solution to question 1, in the table, interchange the column headings  ${}_t p_x$  and  $q_{x+t}$ .

[8/19/2009] On page 988, the solutions to questions 13 and 14 are misnumbered 12 and 13 respectively.

[8/19/2009] On page 989, in the solution to question 26:

- On the third line, change 2,358,256 in the numerator to 2,358,246.
- On the displayed line and the line after it, change 14,681,400,000 to 146,814,000.

[8/19/2009] On page 990, in the solution to question 37, in the table, interchange  $l_{x+20}$  and  $l_x$  at the heads of the third and fourth columns.

[8/18/2009] On page 994, in the solution to question 23, on the first line, change  ${}_k p_{xy}$  to  ${}_k p_{\overline{xy}}$ .

[8/19/2009] On page 1015, in the solution to question 2, on the last line, remove the minus sign in front of  $\frac{5}{1.7406}$ .

[8/18/2009] On page 1023, in the solution to question 2, on the 4th displayed line, there should be a  $dt$  before the equal sign.

[8/18/2009] On page 1028, in the solution to question 36, on the second line, change the denominator 796 to 776.

[8/20/2009] On page 1030, in the solution to question 6, on the second displayed line, change  $\frac{x^2}{100}$  to  $\frac{x^2}{10,000}$ .

[8/20/2009] On page 1033, in the solution to question 27, the heading of the fifth column of the table should be  ${}_t p_{65}^{(\tau)} = {}_{t-1} p_{65}^{(\tau)} (1 - q_{65+t-1}^{(\tau)})$ .

[8/19/2009] On page 1036, in the solution to question 4, the last denominator on the first displayed line is missing a pair of parentheses and should be  $(1 - 0.0653)^2$ .

[8/19/2009] On page 1037, the second sentence is incorrect, since the premiums are paid at different times, resulting in different accumulated values. The correct solution to question 7 is:

From a retrospective viewpoint, the accumulated benefit is the same, so the higher the accumulated premium, the higher the reserve. In all cases, the premiums have a total of 10, so the earlier highest accumulated

benefit will be from the premiums paid earliest, which accumulate more interest. (E) clearly has the earliest premiums, since all patterns have 6 in the first 3 years but only (E) collect 3 in the first year. (E)

[8/19/2009] On page 1038, in footnote 1, delete one of the double vertical lines after 893.

[8/20/2009] On page 1043, in the solution to question 11, on the second line,  $\frac{s_2^2}{s_2^2}$  should be  $\frac{s_2^2}{s_1^2}$ . Also,  $F(12, 11)$  should be  $kF(12, 11)$ .

[8/20/2009] On page 1046, in the solution to question 40, on the third line, “change” should be “chance”.

[8/20/2009] On page 1048, in the solution to question 12, on the second line, change  $2(10^7)$  to  $2(10^{14})$  in two places.

[1/24/2010] On page 1064, the columns for practice exam 6 and 7 are interchanged.