Errata and updates for ASM Exam MLC (Ninth Edition) sorted by page

Note: In practice exam 3, make the change to question 4 noted below (page 1085). Practice exam 5:20 is defective in that none of the five answer choices is correct. In practice exam 8, questions 15 and 19 are defective; make the emendation to question 22 noted below (page 1125).

Errors dated before 12/7/09 are already corrected in the second printing of the ninth edition.

[1/24/2010] On page 26, in the solution to exercise 2.4, on the fourth line, change Var(mn) to Var(mN).

[7/22/2010] On page 34, on the sixth line, change "on starts" to "one starts".

[6/9/2010] On page 34, fourth line of Section 3.3, change the three arguments x to t:

$s_{T(x)}(t) = \Pr\big(T(x) > t\big)$. (*Models for Quantifying Risk* uses $S(t)$ instead of $s(t)$.)

[7/22/2010] On page 34, third line from the bottom, change $X \geq 40$ to $X > 40$.

[12/22/2009] On page 35, in Table 3.1, on the first two lines of "Mathematical Probability Functions" on the right hand side, delete the extra (x) in the subscript and add an argument (t), so that you get $s_{T(x)}(t)$ and $F_{T(x)}(t)$. On the last line, change the numerator of the fraction to $F_X(x+t+u) - F_X(x+t)$, and in the denominator make the x in parentheses lowercase.

[12/4/2009] On page 38, in the table for question 3.7, the 0.07 in the last column should be on the line for $x = 62$. Also, the 70 in the d_x column, row for $x = 62$, should be deleted, although it is correct, since the intention of the question was for the student to derive that value.

[12/4/2009] On page 41, the solution to exercise 3.7 is incomplete. The correct solution is

Did you notice that you are given ${}_{x-60|}q_{60}$ rather than q_x?

Since ${}_{2|}q_{60} = 0.07$, then $d_{62} = 0.07 l_{60} = 70$ and $l_{62} = l_{63} + d_{62} = 780 + 70 = 850$. Then $l_{61} = 850 + d_{61} = 950$ and $d_{60} = l_{60} - l_{61} = 1000 - 950 = 50$, so $q_{60} = d_{60}/l_{60} = 50/1000 = \boxed{\mathbf{0.05}}$.

[7/15/2010] On page 41, in the solution to exercise 3.9, on the third line, ${}_{15}p_{50}$ is 0.54, not 0.6.

[12/2/2009] On page 45, in formula (4.1), there should be an "ln" before the last $s_X(x)$:

$$\mu_x = \frac{f_X(x)}{s_X(x)} = -\frac{\mathrm{d}}{\mathrm{d}x} \ln s_X(x)$$

[1/24/2010] On page 46, two lines above Quiz 4-1, change the denominator $65+60$ to $65+70$.

[1/10/2010] On page 56, in exercise 4.30, change ${}_t p_x$ to p_x once apiece on lines 1 and 3, and change $s \leq t$ to $s \leq 1$ once apiece on lines 1 and 2.

[6/28/2010] On page 61, in the solution to exercise 4.23, 3 lines from the end, change "legs of lengths 0 and 1" to "legs of length 0.5 and 1".

[1/10/2010] On page 63, in the solution to exercise 4.30, on the displayed line, change $e^{-0.2}$ to $e^{0.05}$.

[12/11/2009] On page 68, the second displayed equation in Subsection 5.1.2 is missing an x and should be

$$s_{T(x)}(t) = \frac{\omega - x - t}{\omega - x}$$

[1/24/2010] On page 69, on the second line, change $\omega = 70$ to $\omega - x = 70$.

[2/3/2010] On page 69, 5 lines from the bottom of the page, replace the formula with

$$f_{T(x)}(t) = \frac{\alpha(\omega - x - t)^{\alpha-1}}{(\omega - x)^{\alpha}}$$

[2/8/2010] On page 69, on the last line of the page, add an α to the numerator:

$$\text{Var}\Big(T(x)\Big) = \frac{\alpha(\omega-x)^2}{(1+\alpha)^2(2+\alpha)}$$

[5/16/2010] On page 79, two lines below formula (6.4), change $\mathbf{E}\,[T(x),n]$ to $\mathbf{E}\left[\min\Big(T(x),n\Big)\right]$.

[1/15/2010] On page 80, on the first two displayed lines of the answer to Example 6A, replace $\mathrm{d}t$ with $\mathrm{d}u$.

[12/14/2009] On page 81, on the second line, change $\mathring{e}_{30:\overline{40|}}$ to $\mathring{e}_{30:\overline{25|}}$.

[12/15/2009] On page 81, on the second displayed line of Subsection 6.1.2, the left hand side should be $\mathbf{E}\Big[\Big(T(x)\wedge n\Big)^2\Big]$. Three lines further down, replace the final result with $\dfrac{1-(1+\mu n)e^{-\mu n}}{\mu^2}$. On the next line, replace the equation with $\text{Var}\Big(T(x)\wedge n\Big) = \mathbf{E}\Big[\Big(T(x)\wedge n\Big)^2\Big] - \mathring{e}^2_{x:\overline{n|}}$.

[3/1/2010] On page 81, on the last line, add an α to the numerator:

$$\text{Var}\Big(T(x)\Big) = \frac{\alpha(\omega-x)^2}{(\alpha+1)^2(\alpha+2)}$$

[12/23/2009] On page 83, on the last line of the answer to Example 6E, change the first $\dfrac{3}{8}$ to $\dfrac{5}{8}$ and change the final answer to 276.692708.

[1/28/2010] In the second printing only, on page 84, two lines above Section 6.2, replace the line with $= \text{Var}(1/2,1) + \mathbf{E}[1/12,0]$.

[1/5/2010] On page 86, in the answer to Example 6F, on lines 3–5, the left hand sides should be ${}_2p_{90}$, ${}_3p_{90}$, and ${}_4p_{90}$ respectively.

[12/20/2009] On page 87, in the answer to Example 6G, change 99.50008 to 99.5008.

[1/20/2010] On page 87, on the first line of the answer to Example 6H part 3, change (6.12) to (6.13).

[12/20/2009] On page 96, in the solution to exercise 6.4, on the first line, change the reference to formula (6.16) to (6.15).

[12/20/2009] On page 96, in the solution to exercise 6.10, on the second and third lines, change the second denominators to $2(\omega-20)$.

[1/24/2010] On page 99, the solution to exercise 6.20 is incorrect. The correct solution is

For this deMoivre, we have

$$\begin{aligned}
e_{10:\overline{20|}} &= \mathring{e}_{10:\overline{20|}} - 0.5\,{}_{20}q_{10} \\
18 &= 20\,{}_{20}p_{10} + 9.5\,{}_{20}q_{10} \\
&= 20 - 10.5\,{}_{20}q_{10} \\
{}_{20}q_{10} &= \frac{2}{10.5} = \frac{4}{21} \\
\frac{20}{\omega-10} &= \frac{4}{21} \\
\omega &= \boxed{\mathbf{115}}
\end{aligned}$$

[6/9/2010] On page 103, in the solution to Quiz 6-1, a negative sign is missing on the right of the first displayed line, and the second displayed line's terms should be reversed:

$$\begin{aligned}\int_{50}^{50+t} \mu_x \, dx &= -\ln(10-\sqrt{x})\Big|_{50}^{50+t} \\ &= \ln(10-\sqrt{50}) - \ln(10-\sqrt{50+t})\end{aligned}$$

[12/20/2009] On page 103, on the second displayed line of the solution to Quiz 6-3, change the left hand side to $\mathbf{E}\left[\left(K(20)\wedge 3\right)^2\right]$

[12/24/2009] On page 103, on the second displayed line of the solution to Quiz 6-4, put a presubscript of 24 before the last q_{20}: $11.5_{24}q_{20}$.

[1/27/2010] On page 110, in Table 7.1, formula (7.4), replace the subscript $x+k$ with $x+1$.

[2/1/2010] On page 121, in the solution to exercise 7.17, replace the fourth line with

$$_tp_{40} = \exp\left(-\int_0^t \frac{du}{k-(40+u)}\right)$$

[12/27/2009] On page 134, on the line below the first displayed line, change "ou" to "you".

[5/25/2010] On page 150, in the solution to exercise 8.14, on the 6th line, change $T^2\wedge 2$ to $(T\wedge 2)^2$.

[6/28/2010] On page 153, in the solution to exercise 8.23, on the second line, delete the period in 7,126,0.36.

[12/5/2009] On page 156, in the solution to exercise 8.36, add a period after $(1-tq_x)$.

[3/15/2010] On page 157, in the solution to exercise 8.39II, the first numerator should be $\frac{1}{3}q_x$.

[12/12/2009] On page 162, in the answer to Example 9C, on the second displayed line, change $_2p_{[47]}$ to $_2p_{[45]+2}$. The last line of the answer is incorrect. Replace it with

The answer is $_{2|2}q_{[45]} = {}_2p_{[45]}(1-{}_2p_{[45]+2}) = 0.995849(1-0.992642) = \boxed{\mathbf{0.007327}}$.

[12/27/2009] On pages 163–164, in the tables at the bottom of page 163 and the top of page 164, change the second 44 under $x+3$ to 45.

[6/14/2010] On pages 163–164, in the last table on page 163 and the first table on page 164, on the line for age 42, change 9.586,465 to 9,586,464.

[12/27/2009] On page 179, the solution to Quiz 9-3 is incorrect. The correct solution is

We must go from $l_{[80]}$ to l_{83}, then back to $l_{[81]}$.

$$\begin{aligned}q_{[80]} &= 0.5(0.1) = 0.05 \\ q_{[80]+1} &= 0.8(0.2) = 0.16 \\ l_{83} &= 1000(1-0.05)(1-0.16)(1-0.3) = 558.6 \\ q_{[81]} &= 0.5(0.2) = 0.1 \\ q_{[81]+1} &= 0.8(0.3) = 0.24 \\ l_{[81]} &= \frac{558.6}{(1-0.1)(1-0.24)} = \boxed{\mathbf{816.67}}\end{aligned}$$

[1/20/2010] On page 181, in the second displayed equation the left hand side should be $\ddot{a}_{\overline{n}|}$, and in the third displayed equation the left hand side should be $\bar{a}_{\overline{n}|}$.

[5/16/2010] On page 187, on the last displayed line, delete δ from the exponent of v.

[2/24/2010] On page 189, the first six lines of the page are not well stated. Replace them with

For the deferred insurance, we will use formula

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

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

$$\begin{aligned} {}_5E_x &= e^{-5(0.01+0.06)} = 0.704688 \\ {}^2_5E_x &= e^{-5(0.01+0.12)} = 0.522046 \end{aligned}$$

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

$$\begin{aligned} \bar{A}_{x+5} &= \frac{\mu}{\mu+\delta} = \frac{0.02}{0.02+0.06} = 0.25 \\ {}^2\bar{A}_{x+5} &= \frac{\mu}{\mu+2\delta} = \frac{0.02}{0.02+0.12} = \frac{1}{7} \end{aligned}$$

[12/9/2009] On page 191, on the first line of the page, remove the bar from $\bar{A}$.

[1/9/2010] On page 201, the solution to exercise 10.12 is incorrect. The correct solution is

The 30-year term insurance has $\delta = \ln(1+i) = \ln 1.04$, so its expected present value is

$$\frac{0.02}{0.02+\ln 1.04}(1-e^{-30(0.02+\ln 1.04)}) = 0.280575$$

The pure endowment paid when $T \geq 30$ has present value 0.5 if paid and expected present value $0.5e^{-30(0.02)} = 0.274406$. The total expected value of Z is $\mathbf{E}[Z] = 0.280575 + 0.274406 = \boxed{\mathbf{0.55498}}$.

[1/20/2010] On page 201, in the solution to exercise 10.13, on the first displayed line, replace ${}_kE_{x+1}$ with ${}_{k+1}E_x$. Also, a 2 is missing from the right hand side, which should be $\frac{2e^{-0.06k}}{3}\left(1-e^{-0.06}\right)$. The other 3 displayed lines should be replaced with

$$\begin{aligned} \bar{A} &= 1000\left(\frac{2(1-e^{-0.06})}{3}\right)\sum_{k=0}^{\infty} e^{-0.06(2k+1)} \\ &= 38.8236\left(\frac{e^{-0.06}}{1-e^{-0.12}}\right) \\ &= 38.8236(8.328335) = \boxed{\mathbf{323.34}} \end{aligned}$$

[6/14/2010] On page 205, in the solution to exercise 10.31, on the first displayed line, change 0.4 to 0.04.

[12/31/2009] On page 206, in the solution to Quiz 10-2, the last line should be

$$\bar{A} = 10\left(\frac{0.02}{0.01}\right) = \boxed{\mathbf{20}}$$

[12/21/2009] On page 209, in Example 11C(i), change $1/(50-t)$ to $2/(50-t)$.

[2/1/2010] On page 213, in Table 11.2, formulas (11.4) and (11.5), replace every n (one in (11.4), three in (11.5)) with u.

[1/21/2010] On page 220, in the solution to exercise 11.5, on the second line, delete $\int_0^{60} e^{-0.06t}\,dt$.

[1/21/2010] On page 221, in the solution to exercise 11.10, replace $\bar{a}_{\overline{75}|}$ with $\bar{a}_{\overline{25}|}$ on the first and fourth displayed lines.

[12/15/2009] On page 225, the solution to Quiz 11-1 is incorrect. Replace the three displayed lines with

$$\bar{A}^{1}_{30:\overline{20}|} = \frac{\bar{a}_{\overline{20}|}}{90} = \frac{1-e^{-0.04(20)}}{90(0.04)} = 0.152964$$

$$\bar{A}_{30:\overline{20}|^{1}} = e^{-0.04(20)}\left(\frac{70}{90}\right) = 0.349478$$

$$\bar{A}_{30:\overline{20}|} = 0.152964 + 0.349478 = \boxed{\mathbf{0.5024}}$$

[1/3/2010] On page 226, the first line of the page is incorrect, resulting in the other lines being incorrect. The solution is unnecessarily complicated. A better solution is

Let Z_3 be a 10-year pure endowment. Then

$$\mathbf{E}[Z_3] = \mathbf{E}[Z_2] - \mathbf{E}[Z_1] = 0.6518 - 0.0820 = 0.5698 = v^{10}\,{}_{10}p_x \qquad (*)$$

and

$$\begin{aligned}
\text{Var}(Z_2) &= \text{Var}(Z_1) + \text{Var}(Z_3) - 2\,\mathbf{E}[Z_1]\,\mathbf{E}[Z_3] \\
0.0158 &= 0.0625 + \text{Var}(Z_3) - 2(0.0820)(0.5698) \\
\text{Var}(Z_3) &= 0.0158 - 0.0625 + 2(0.0820)(0.5698) = 0.046747 = v^{20}\,{}_{10}p_x\,(1 - {}_{10}p_x) \qquad (**)
\end{aligned}$$

We divide (**) by (*) to get

$$v^{10}(1 - {}_{10}p_x) = \frac{0.046747}{0.5698} = 0.082041$$

Adding this result to (*), we get

$$v^{10} = 0.082041 + 0.5698 = 0.651841$$

$$\delta = -\ln v = -\frac{\ln 0.651841}{10} = \boxed{\mathbf{0.04280}}$$

[2/9/2010] On page 228, two lines below formula (12.3), change $\mathbf{E}[Z]$ to $\mathbf{E}[Z^2]$.

[2/9/2010] On page 228, on the third line of the answer to Example 12B, change "endowment insurance" to "pure endowment".

[12/30/2009] On page 230, 3 lines from the bottom, change "force of interest" to "interest factor".

[12/30/2009] On page 231, on the 7th line, capitalize the "y" in "you".

[2/9/2010] On page 251, in the solution to exercise 12.33, on the second line from the end, put a minus sign before $b/2a$.

[3/12/2010] On page 253, in the solution to exercise 12.41, on the second displayed line, change the presubscript of q to $0.25k|0.25$.

[1/7/2010] On page 254, in the last three lines of Quiz 12-1:

- Replace $e^{-0.02}$ with $e^{-0.2}$
- Replace the second to last line with $(0.457175)(0.315237) = 0.144119$.
- On the last line, replace 0.172541 with 0.144119 and 307.23 with 278.81.

The single benefit premium for the insurance is $1000A_{60} = 1000(0.134693 + 0.144119) = \boxed{\mathbf{278.81}}$.

[3/5/2010] On page 254, in the solution to Quiz 12-2, remove the four bars from the A's.

[2/21/2010] On page 257, third line of answer to Example 13A, change $T < -(\ln 0.25)/\delta$ to $T > -(\ln 0.25)/\delta$.

[6/14/2010] On page 258, on the third line of the answer to Example 13C, replace the two subscripts 30 with 40.

[3/6/2010] On page 260, on the second line, replace "pth percentile of Z" with "$100p$th percentile of Z".

[1/31/2010] On page 260, 4 lines above Example 13G, change $\Pr(Z > z)$ to $\Pr(Z < z)$.

[1/10/2010] On page 262, in Quiz 13-3, on the first line, change "at the end of the year" to "at the moment of". For discrete insurances, the percentile is not well-defined, and while the answer given in the manual is correct, it is not the only answer.

[1/25/2010] On page 266, in question 13.21, delete the word "percentile" on the last line.

[5/16/2010] On page 267, in the solution to exercise 13.4, delete the extra "f" in Ffigure.

[12/18/2009] On page 268, the solution to exercise 13.8 is incorrect. The correct solution is

If $v^T = 0.5$, then $T = (\ln 0.5)/(\ln v) = -(\ln 0.5)/(\ln 1.06) = 11.8957$. Thus $Z > 500$ if and only if $K + 1 \le 11$, which means death occurs within the first 11 years. Under deMoivre, the probability of this is ${}_{11}q_{20} = 11/80 = \boxed{\mathbf{0.1375}}$.

[12/18/2009] On page 269, the solution to exercise 13.9 is incorrect. The correct solution is

If $v^T = 0.6$, then $T = (\ln 0.6)/(\ln v) = -(\ln 0.6)/(\ln 1.06) = 8.7667$. Thus $Z \le 600$ if and only if $K + 1 \ge 9$, which means survival for 8 years. Using the ILT, ${}_8p_{45} = l_{53}/l_{45} = 8{,}779{,}128/9{,}164{,}051 = \boxed{\mathbf{0.95800}}$. Notice that the answer would've been the same for a whole life policy or a 20-year term policy.

[12/18/2009] On page 279, Example 14C is defective and the answer is incorrect. Change (i) to $A_{85} - A_{65} = 0.15$. Change the 6 displayed lines of the answer to

$$\begin{aligned} A_{65} &= A^{\overline{1}}_{65:\overline{20|}} + {}_{20}E_{65}\,A_{85} \\ &= A_{65:\overline{20|}} - {}_{20}E_{65} + {}_{20}E_{65}(A_{65} + 0.15) \\ &= 0.7 + {}_{20}E_{65}(-0.85 + A_{65}) \\ &= 0.7 + 0.5(-0.85 + A_{65}) \\ 0.5A_{65} &= 0.275 \\ A_{65} &= \boxed{\mathbf{0.55}} \end{aligned}$$

[2/23/2010] On page 281, the denominator of equation (14.6) should be $(\mu + 2\delta)^3$.

[3/12/2010] On page 281, 2 lines from the bottom, $\bar{A}_{x\overline{10|}}$ should be $\bar{A}^1_{x:\overline{10|}}$..

[2/24/2010] On page 283, in formula (14.11), change the subscript of the last term to $x + 1 : \overline{n-1|}$: $v\,p_x(IAA)_{x+1:\overline{n-1|}}^{\overline{1}}$.

[2/1/2010] On page 286, in Table 14.1, formulas (11.4) and (11.5), replace every n (one in (11.4), three in (11.5)) with u.

[2/23/2010] On page 286, the denominator of equation (14.6) should be $(\mu+2\delta)^3$.

[1/11/2010] On page 292, in question 14.20, on the first line, add "at the moment of death" after the word "death".

[2/13/2010] On page 301, in the solution to exercise 14.22, the final answer should be multiplied by 1000, and is $\boxed{\textbf{1160}}$.

[12/18/2009] On page 303, the solution to Quiz 14-1 is incorrect. The correct solution is

By the recursive formula,

$$\begin{aligned} 0.12966 &= 0.006v + (0.994v)(0.13032) \\ &= 0.135538v \\ 1+i &= \frac{0.135538}{0.12966} = 1.04533 \\ i &= \boxed{\textbf{0.0453}} \end{aligned}$$

[1/9/2010] On page 304, the final answer to Quiz 14-3 should be 0.9771 instead of 0.8926. A simpler way to solve the quiz, after getting $(IA)^1_{40:\overline{20|}} = 0.98$, is

Use formula (14.11). $(IAA)^1_{41:\overline{19|}}$ is the same for both mortality tables. We'll use primes for the modified mortality table. We have

$$(IAA)^1_{41:\overline{19|}} = \frac{0.98 - 0.005(0.95)}{0.995v} = \frac{0.980151}{v}$$

and

$$(IA)^1_{40:\overline{20|}} = 0.9v\left(\frac{0.980151}{v}\right) + 0.1(0.95) = \boxed{\textbf{0.9771}}$$

[5/7/2010] On page 308, in Table 15.1, equation (15.4), put a bar on the $A_{x:\overline{n|}}$ on the left-hand side.

[3/23/2010] On page 310, while exercise 15.11 can be worked out as indicated in the solution, the values given are inconsistent, since the second moment of an insurance of 1 must always be less than the first moment. Also, in (i), change 1000 to 1.

[1/9/2010] On page 315, the solution to Quiz 15-1 is incorrect. A replacement page is at `MLC9ReplacementPages.pdf`.

[2/21/2010] On page 318, in Table 16.1, "Deferred life annuity" line, "Present value" column, change t to T.

[2/21/2010] On page 319, on the fifth line, replace $a_{\overline{T|}}$ with $\bar{a}_{\overline{T|}}$.

[2/21/2010] On page 322, on the first displayed line of the answer to Example 16D, remove δ from the denominator.

[2/21/2010] On page 328, in exercise 16.15, on the first line, delete the second "You are given".

[3/15/2010] On page 330, in the solution to exercise 16.3, on the first line, put a bar on $A_{40:\overline{10|}}$.

[3/16/2010] On page 331, in the solution to exercise 16.9, on the third displayed line, change the presubscript from 5 to 5|.

[12/5/2009] On page 332, in the solution to exercise 16.11, on the 6th line, change equatio to equation.

[12/21/2009] On page 333, in the solution to exercise 16.18, multiply the final answer by 10, or add the line

$$\bar{a}_{30:\overline{20|}} = \boxed{\textbf{90.484}}$$

[12/22/2009] On page 337, in Example 17A, the last column of the table should be headed $\ddot{a}_{\overline{k+1|}}$. The answer is incorrect. Here is an answer that uses an improved version of equation (17.5):

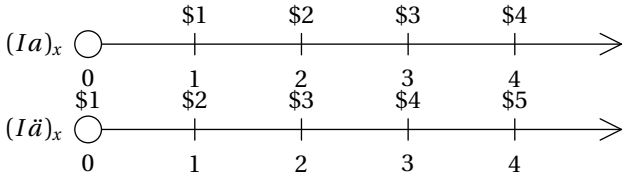
$$\ddot{a}_{x:\overline{n|}} = \sum_{k=1}^{n-1} \ddot{a}_{\overline{k|}}\, {}_{k-1|}q_x\, q_{x+k-1} + \ddot{a}_{\overline{n|}}\, {}_{n-1}p_x$$

The probabilities of death in each of the first two years is given in the second column of the table, since ${}_{k|}q_x = {}_k p_x\, q_{x+k}$. The probability of survival for 2 years is ${}_2p_x = 1-0.10-0.15-0.75$. Using formula (17.5), the expected present value of the 3-year temporary life annuity is

$$\ddot{a}_{x:\overline{3|}} = 0.10(1)+0.15(1.92)+0.75(2.75) = \boxed{\mathbf{2.4505}}$$

[1/24/2010] On page 339, 4 lines from the bottom, move the diuresis from the second a to the first: $\ddot{a}_{x:\overline{n|}} = a_{x:\overline{n|}} + 1 - {}_nE_x$.

[12/5/2009] On page 342, the first two timelines are incorrect. Replace them with these two timelines:



On the line after the third timeline, replace $(D\ddot{a})_x$ with $(D\ddot{a})_{x:\overline{n|}}$.

[3/19/2010] On page 343, on the first line of the answer to Example 17G, change (17.1) to (17.3).

[4/3/2010] On page 344, in the last timeline of the page (4 lines from the end), add $x+$ before the last four expressions $n-2$, $n-1$, n and $n+1$:

[2/21/2010] On page 346, on the first line of the answer to Example 17J, change ${}_{10}E_{55}$ to ${}_{10}E_{45}$.

[2/21/2010] On page 346, once apiece on the two displayed lines of the answer to Example 17K, change ${}_{10}E_{65}$ to ${}_{10}E_{55}$.

[12/23/2009] On page 355, in exercise 17.25, the three annuities of (i), (ii), and (iii) should all be due; put double-dots on top of each a.

[12/23/2009] On page 367, in the solution to exercise 17.25, interchange the two a's on the first displayed line:

$$a_{x:\overline{30|}} = \ddot{a}_{x:\overline{31|}} - 1 = 17$$

[1/11/2010] On page 368, the solution to exercise 17.30 is incorrect. The correct solution is

The annuity is like an 11-year deferred annuity due except that it also pays $\ddot{a}_{\overline{11|}}$ if (45) survives 10 years. Therefore

$$\begin{aligned}\mathbf{E}[Y] &= {}_{11}E_{45}\, \ddot{a}_{56} + {}_{11}p_{45}\, \ddot{a}_{\overline{11|}} \\ &= \left(\frac{0.52652}{1.06}\right)\left(\frac{8{,}563{,}435}{8{,}640{,}861}\right)(12.0604) + \left(\frac{8{,}563{,}435}{9{,}164{,}051}\right)\left(\frac{1-(1/1.06^{11})}{0.06/1.06}\right)\end{aligned}$$

$$= 5.93693 + (0.934460)(8.360087) = \boxed{\mathbf{13.75}}$$

[2/21/2010] On page 369, in the solution to exercise 17.33, on the first displayed line, change $\mathbf{E}[Z]$ to $\mathbf{E}[Y]$.

[2/12/2010] On the last two lines of page 375, the + before δ^2 should be − and the + in equation (18.6) should be −:

$$= \frac{1 - 2\delta\,{}^2\bar{a}_{x:\overline{n}|} - 1 + 2\delta\,\bar{a}_{x:\overline{n}|} - \delta^2(\bar{a}_{x:\overline{n}|})^2}{\delta^2}$$
$$= \frac{2(\bar{a}_{x:\overline{n}|} - {}^2\bar{a}_{x:\overline{n}|})}{\delta} - (\bar{a}_{x:\overline{n}|})^2$$

[12/24/2009] On page 380, in Quiz 18-2, add the words "the variance of" after the word "Calculate".

[2/12/2010] On page 382, in Table 18.1, in equation (18.6), change the + sign to a −:

$$\frac{2(\bar{a}_{x:\overline{n}|} - {}^2\bar{a}_{x:\overline{n}|})}{\delta} - (\bar{a}_{x:\overline{n}|})^2$$

[11/18/2009] On page 389, in the solution to exercise 18.1, in the second bullet, change $\mathbf{E}[T(x)]^2$ to $\mathbf{E}[T(x)^2]$.

[1/11/2010] On page 389, in exercise 18.31, at the end of the first line, delete the s in deaths.

[4/9/2010] On page 390, in the solution to exercise 18.4, on the third displayed line, add μ before the second slash.

[1/29/2010] On page 396, the final answer to exercise 18.23 should be $\boxed{\mathbf{0.23503}}$.

[4/9/2010] On page 397, in the solution to exercise 18.27, change "is" to "if".

[12/24/2009] On page 399, the solutions to Quizzes 18-2 and 18-3 are incorrect. A replacement page is provided at `MLC9ReplacementPages.pdf`.

[2/21/2010] On page 403, change the caption of Figure 19.3(d) to "10 year certain & life annuity".

[4/9/2010] On page 404, on the first line of the answer to Example 19B, change 20 to 16.

[5/10/2010] On page 404, on the second line of Example 19C, delete "actuarial".

[2/21/2010] On page 405, in Quiz 19-1, on the first line, change (40) to (70).

[11/18/2009] On page 405, 1 line above Example 19E, change "are greater" to "is greater".

[2/21/2010] On page 405, in the answer to Example 19E, on the first displayed line, remove the bar from $\bar{A}_{55}$.

[12/25/2009] On page 406, replace the last two lines of the answer to Example 19F with

The value of the annuity-certain paying 2 per year for 25 years and 1 per year from $t = 25$ to $t = 35.09925$ is

$$\frac{1 - e^{-0.05(25)}}{0.05} + \frac{1 - e^{-0.05(35.09925)}}{0.05} = 14.2699 + 16.5417 = \boxed{\mathbf{30.8116}}$$

[3/27/2010] On page 409, replace the 3 lines after the answer to Example 19I with

A whole life annuity on x may be split into an n-year temporary annuity plus an n-year pure endowment factor times an annuity on $x + n$.

$$\ddot{a}_x = \ddot{a}_{x:\overline{n}|} + {}_nE_x\,\ddot{a}_{x+n}$$

[12/5/2009] On page 419, in the solution to exercise 19.4, on the 6th displayed line, change t to T.

[1/11/2010] On page 420, the solution for exercise 19.8 is for a 20-year deferred annuity, but the question asks for a 10-year deferred annuity. The correct solution is:

The actuarial present value of the deferred annuity is, by the current payment formula with $v^k = 1$,

$$\sum_{k=10}^{\infty} e^{-0.01k} = \frac{e^{-0.1}}{1-e^{-0.01}} = 90.937$$

The probability of more than 90 payments is the probability of surviving 100 years, or $e^{-0.01(100)} = \boxed{\mathbf{0.3678}}$.

[4/21/2010] On page 420, in the solution to exercise 19.12, change the left hand side of the second displayed line from ${}_{3|}\bar{a}_t$ to ${}_{3|}\bar{a}_{\overline{t-3}|}$.

[4/11/2010] On page 421, on the last line of the solution to exercise 19.15, change the left-hand side to ${}_{24.3642}p_{35}$.

[4/11/2010] On page 422, on the second line of the solution to exercise 19.21, change 0.5 to 0.4.

[2/21/2010] On page 426, on the first displayed line of the solution to Quiz 19-1, change the subscript $\overline{T}|$ to $\overline{t}|$.

[1/9/2010] On page 427, in the solution to Quiz 19-3, change both 60's to 20's. While the 25th percentile of age at death is 60, the 25th percentile of time to death is 20.

[4/15/2010] On page 440, two lines above the last displayed line on the page, delete "a" and change "aer" to "are".

[2/23/2010] On page 443:

- In the answer to Example 21E, first displayed line, change $\bar{a}_{40}$ to $\bar{a}_{\overline{10}|}$.
- In the answer to Example 21F, second displayed line, change $\mu+\pi$ to $\mu-\pi$

[12/28/2009] On page 452, in the solution to exercise 21.15, on the second displayed line, replace $\overline{n}|$ with $\overline{20}|$. Replace the last two lines of the solution with

Then $A_{x:\overline{20}|}^{\frac{1}{}} = 0.40594 - 0.15 = 0.25594 = {}_{20}p_x\, e^{-20(0.06)}$, so

$${}_{20}p_x = 0.25594e^{1.2} = \boxed{\mathbf{0.8498}}$$

[1/11/2010] On page 454, in the solution to exercise 21.20, on the third line from the end, replace 455.067 with 349.403. On the last line, replace 465.067 with 359.403 and 40.88 with 31.59.

[1/30/2010] On page 454, change double-dot to bar on top of the a's on line 2 of the solution to Quiz 21-1 and lines 3 and 6 of the solution to Quiz 21-2. On line 3 of the solution to Quiz 21-2, switch $\bar{A}_{50:\overline{20}|}$ and $\bar{a}_{50:\overline{20}|}$: $\bar{A}_{50:\overline{20}|} = 1-\delta\,\bar{a}_{50:\overline{20}|}$.

[5/16/2010] On page 458, on the third line, change ${}_{20|}\ddot{a}_{65}$ to ${}_{20|}\ddot{a}_{45}$.

[2/22/2010] On page 458, on the fourth and fifth lines, change ${}_{k-1}q_{45}$ to ${}_{k-1|}q_{45}$.

[1/10/2010] On page 458, in Quiz 22-3, on the second line, change 4% to 6%. In (iii), change $x \le 65$ to $x < 65$ and $x > 65$ to $x \ge 65$.

[1/27/2010] On page 461, in Table 22.1, on the line after **Constant Mortality**, change $P_{x:\overline{n}|} = vq_x$ to $P^1_{x:\overline{n}|} = vq_x$.

[7/25/2010] On page 466, in exercise 22.15, add "of 1" after "insurance".

[4/7/2010] On page 478, in the solution to exercise 22.3, on the first displayed line, ${}_{k-1}p_x$ is missing. It should read

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

[4/3/2010] On page 488, the last four lines of the solution to exercise 22.38 are incorrect. Replace them with:

$$(IA)^{1}_{20:\overline{10}|} = \frac{1}{80}\sum_{k=1}^{10} k v^k = \frac{(Ia)_{\overline{10}|}}{80} = \frac{\ddot{a}_{\overline{10}|} - 10/1.05^{10}}{80(0.05)} = \frac{8.107822 - 6.139133}{4} = 0.492172$$

Substituting into (*),

$$7.692389\pi = 0.492172\pi + 8163.541$$
$$\pi = \frac{8163.541}{7.692389 - 0.492172} = \boxed{\mathbf{1133.79}}$$

[1/11/2010] On page 488, in the solution to exercise 22.39, replace the fourth displayed line with

$$a_{20:\overline{10}|} = \sum_{k=0}^{9}\left(\frac{0.99}{1.05}\right)^k = \frac{1-(0.99/1.05)^{10}}{1-(0.99/1.05)}$$
$$\ddot{s}_{20:\overline{10}|} = \left(\frac{1.05}{0.99}\right)^{10}\ddot{a}_{20:\overline{10}|} = \left(\frac{1.05}{0.99}\right)^{10}\left(\frac{1-(0.99/1.05)^{10}}{1-0.99/1.05}\right) = 14.01948$$

and the last line with

$$\pi = \frac{17{,}500}{0.5(13.20679 + 14.01948)} = \boxed{\mathbf{1285.52}}$$

[11/18/2009] On page 491, in the solution to exercise 22.50, on the fourth line, change $\frac{1}{\ddot{a}_{20}}$ to $\ddot{a}_{20}$.

[12/29/2009] On page 492, in the solution to exercise 22.57, on the second displayed line, change 0.04 to 0.02. Replace the last two lines with

$$0.06 - {}_nP_x = 0.05(1-0.4) = 0.03$$
$${}_nP_x = 0.06 - 0.03 = \boxed{\mathbf{0.03}}$$

[12/29/2009] On page 493, in the solution to exercise 22.57, on the second displayed line, change 0.04 to 0.02. Replace the last two lines with

$$0.06 - {}_nP_x = 0.05(1-0.4) = 0.03$$
$${}_nP_x = 0.06 - 0.03 = \boxed{\mathbf{0.03}}$$

[1/10/2010] With the corrections to Quiz 22-3 mentioned above, the printed solution is correct. Without the corrections, the question is much more difficult than a typical exam question. The following is the solution to Quiz 22-3 as stated in the manual before the corrections:

Let P be the annual benefit premium for an insurance of 1. By the equivalence principle,

$$P\ddot{a}_{35} = {}_{30|}A_{35} + P\sum_{k=1}^{30}\ddot{s}_{\overline{k}|0.04}(1.06^{-k})\,{}_{k-1|}q_{35}$$

We must evaluate ${}_{30|}A_{35}$, $\ddot{a}_{35}$, and the sum. Since $A_{66} = q/(q+i) = 2/7$, we have

$${}_{30|}A_{35} = \frac{0.99^{30}}{1.06^{30}}\left(\frac{0.01}{1.05} + \frac{0.99}{1.05}\left(\frac{2}{7}\right)\right) = 0.0359208$$

To evaluate $\ddot{a}_{35}$, we split up the different interest and mortality rate periods.

$$\begin{aligned}\ddot{a}_{35} &= \sum_{k=0}^{30}\left(\frac{0.99}{1.06}\right)^k + \left(\frac{0.99}{1.06}\right)^{30}\left(\frac{0.99}{1.05}\right)\sum_{k=0}^{\infty}\left(\frac{0.98}{1.05}\right)^k \\ &= \frac{1-(0.99/1.06)^{31}}{1-0.99/1.06} + \left(\frac{0.99}{1.06}\right)^{30}\left(\frac{0.99}{1.05}\right)\left(\frac{1}{1-0.98/1.05}\right) \\ &= 13.32141 + 1.82145 = 15.14286\end{aligned}$$

The sum is evaluated as follows:

$$\begin{aligned}\sum_{k=1}^{30}\ddot{s}_{\overline{k}|0.04}(1.06^{-k})_{k-1|}q_{35} &= \sum_{k=1}^{30}\left(\frac{1-(1/1.04)^k}{0.04/1.04}\right)\left(\frac{1.04}{1.06}\right)^k(0.01)(0.99^{k-1}) \\ &= \left(\frac{0.01}{0.99}\right)\left(\frac{1.04}{0.04}\right)\sum_{k=1}^{30}\left(\left(\frac{(1.04)(0.99)}{1.06}\right)^k - \left(\frac{0.99}{1.06}\right)^k\right) \\ &= \left(\frac{0.01}{0.99}\right)\left(\frac{1.04}{0.04}\right)\sum_{k=1}^{30}\left(0.971321^k - 0.933962^k\right) \\ &= \left(\frac{0.01}{0.99}\right)\left(\frac{1.04}{0.04}\right)\left(\frac{0.971321-0.971321^{31}}{1-0.971321} - \frac{0.933962-0.933962^{31}}{1-0.933962}\right) \\ &= 1.94335\end{aligned}$$

The premium for the deferred insurance of 1000 is $P = 1000(0.0359208)/(15.14286-1.94335) = \boxed{\mathbf{3.157}}$.

[12/29/2009] On page 497, equation (23.3) should have a square on the last factor:

$$\text{Var}({}_0L) = \left({}^2\bar{A}_{x:\overline{n}|} - (\bar{A}_{x:\overline{n}|})^2\right)\left(1+\frac{P}{\delta}\right)^2$$

Also, on the line above equation (23.3), delete the word "the".

[2/1/2010] On page 498, in equation (23.4), $\bar{A}_{x:\overline{n}|}$ in the numerator should be squared:

$$\text{Var}({}_0L) = \frac{{}^2\bar{A}_{x:\overline{n}|} - (\bar{A}_{x:\overline{n}|})^2}{(1-\bar{A}_{x:\overline{n}|})^2}$$

[5/7/2010] On page 499, in Example 23C(i), change "of 60" to "is 60".

[12/29/2009] On page 500, in Table 23.1, equation (23.3) should have a square on the last factor, as indicated in the erratum for page 497.

[2/1/2010] On page 500, in Table 23.1, in equation (23.4), $\bar{A}_{x:\overline{n}|}$ in the numerator should be squared.

[12/9/2009] On page 507, in the solution to exercise 23.10, on the first two displayed lines, put bars on each $a_{\overline{65}|}$.

[1/11/2010] On page 509, in the solution to exercise 23.20, on the last two lines, change two P's to π's.

[5/16/2010] On page 510, in the solution to Quiz 23-1, on the first two displayed lines, change $a_{\overline{40}|}$ to $\bar{a}_{\overline{40}|}$ and $a_{\overline{40}|0.10}$ to $\bar{a}_{\overline{40}|0.10}$.

[1/30/2010] On page 515, exercise 24.12 should start "$L(x)$ is the variance of the loss-at-issue random variable ...".

[4/3/2010] On page 520, in the solution to exercise 24.12, 5 lines from the end, replace the first ${}^2A_{61}$, the one on the left hand side of the equation, with ${}^2A_{60}$.

[5/16/2010] On page 522, in the solution to exercise 24.18, on the fourth line, change "loss exceeds" to "gains exceed".

[1/10/2010] On page 523, the solution to Quiz 24-1 is incorrect. The correct solution is

Note that ${}_2p_x = 1-0.1-0.2 = 0.7$. The benefit premium is

$$\ddot{a}_{x:\overline{2}|} = 1+(1-0.1)(0.95) = 1.855$$
$$1000P_{x:\overline{2}|}^{\frac{1}{}} = \frac{1000(0.95^2)(0.7)}{1.855} = 340.5660$$

The present value of the loss at issue is

-340.5660 if death occurs in the first year.

$-340.5660(1+0.95) = -664.1038$ if death occurs in the second year.

$1000(0.95^2) - 664.1038 = 238.3962$ if the insured survives two years.

Since the equivalence principle is used, the variance of the loss at issue equals the second moment, which is

$$\text{Var}({}_0L) = 0.1(-340.5660)^2 + 0.2(-664.1038)^2 + 0.7(238.3962)^2 = \boxed{\textbf{139,588}}$$

[12/26/2009] On page 525, in the first sentence of Section 25.1, delete the first "is". At the beginning of the sixth line, change "of issue" to "at issue".

[5/16/2010] On page 530, in the numerator of the first fraction of the last displayed line on the page, change $e^{-0.01t}$ to $e^{-0.04t}$.

[5/16/2010] On page 531, in Example 25J(ii), change i to δ.

[12/30/2009] On page 531, in exercise 25.1(i), add at the end "with $\omega = 100$".

[2/22/2010] On page 532, in exercise 25.2, on the first line, add the words "fully continuous" after "For a".

[2/22/2010] On page 535, in the solution to exercise 25.2, on the 7th line, replace $T = 10$ with $T = 20$ and $t_1 < 10$ with $t_1 < 20$. Replace the last two lines with

$$\Pr(20 < T < t_2) = e^{-20(0.02)} - 0.076825^{0.02/0.05} = 0.31208$$

The answer is $0.04397 + 0.31208 = \boxed{\textbf{0.35603}}$.

[3/26/2010] On page 535, in the solution to exercise 25.3, on the first displayed line, replace $(\ddot{a}_{\overline{10}|} - \ddot{a}_{\overline{1}|})$ with $(\ddot{a}_{\overline{1}|} - \ddot{a}_{\overline{10}|})$. Replace the last paragraph with:

So the loss at issue is 0 at time 32.75. This means that if the annuitant receives the payment associated with the 33rd year, the one paid at the beginning of the 33rd year, the loss at issue will be positive. The probability of that is the probability of surviving 32 years, or $1 - 32/(120-55) = \boxed{\textbf{0.5077}}$.

[12/30/2009] On page 540, in the solution to Quiz 25-2, replace the last two lines with

$$\Pr(1.33v^{K+1} - 0.33 > -0.1) = \Pr\left(1.1^{-(K+1)} > \frac{0.23}{1.33}\right) = \Pr\left(K+1 < -\frac{\ln(0.23/1.33)}{\ln 1.1}\right) = \Pr(K+1 < 18.4120)$$

For $K < 17.4120$, death must occur before time 18. Under deMoivre, ${}_{18}q_{50} = 18/50 = \boxed{\textbf{0.36}}$.

[5/16/2010] On page 542, on the first displayed line of the answer to Example 26B, change the first superscript from (m) to (12).

[1/11/2010] On page 556, in exercise 27.11, on the last line, the 1 should be on top of 40: ${}_{1000}5V^{1}_{40:\overline{10|}}$.

[4/7/2010] On page 563, in the solution to exercise 27.11, on the 8th and 9th displayed lines, replace 0.51675 with 0.51625 and 6.040625 with 6.046875. Three lines later, replace 6.040625 with 6.046875 and 0.012830 with 0.012817. On the second to last line, replace $P^{1}_{45:\overline{5|}}$ with $P^{1}_{45:\overline{10|}}$. On the last line, replace 0.012830 with 0.012817 and the final answer 5.90 with 5.94.

[1/11/2010] On page 565, the solution to exercise 27.17 is incorrect and too complicated. The correct solution is

We just need to calculate P using the equivalence principle. The premium annuity is $P(2\ddot{a}_{45}-\ddot{a}_{45:\overline{20|}})$, or $\Big(2(21.875)-13.950\Big)P=29.8P$. Therefore

$$P=\frac{0.3}{29.8}=0.010067$$

Using the prospective formula, the reserve is

$${}_{20}V=A_{65}-2P\ddot{a}_{65}=0.46-2(0.010067)(16.875)=\boxed{\mathbf{0.1202}}$$

[1/10/2010] On page 567, in the solution to Quiz 27-2, the calculation of A_{20} is incorrect. Replace the denominator $80\ln 1.05$ on that line with 80(0.05). Replace 0.251030 with 0.244956. On the next line, replace 0.251030 with 0.244956 and 15.72837 with 15.85593. On the last line, replace 15.72837 with 15.85593 and 184.29 with 185.41.

[5/16/2010] On page 569, on the last displayed line of the page, change $\ddot{a}_{x:\overline{h-k|}}$ to $\ddot{a}_{x+k:\overline{h-k|}}$ and ${}_hP_{x+k:\overline{h-k|}}^{1}$ to ${}_{h-k}P_{x+k:\overline{h-k|}}^{1}$.

[2/12/2010] On page 570, replace the last 4 lines of the answer to Example 28A, with

$$\begin{aligned}
\ddot{a}_{30:\overline{30|}}&=\frac{1}{P_{30:\overline{30|}}+d}=\frac{1}{0.026+0.03}=17.8571\\
P_{30:\overline{30|}}^{\frac{1}{}}&=\frac{{}_{30}E_{30}}{\ddot{a}_{30:\overline{30|}}}=\frac{(0.8)(0.45)}{17.8571}=0.02016\\
P_{30:\overline{30|}}^{1}&=0.026-0.02016=0.00584
\end{aligned}$$

By the premium difference formula, ${}_{10}V^{1}_{30:\overline{30|}}=15.625(0.0052-0.00584)=\boxed{\mathbf{-0.01}}$.

[2/3/2010] On page 571, in Table 28.2, on the line for h-pay whole life insurance, ${}^{h}_{k}V$ should be ${}^{h}_{k}V_x$.

[4/23/2010] On page 571, replace the three displayed lines below Table 28.2 with

$$\begin{aligned}
{}_t\bar{V}(\bar{A}_x)&=\bar{A}_{x+t}\left(1-\frac{\bar{P}(\bar{A}_x)}{\bar{P}(\bar{A}_{x+t})}\right)\\
{}_kV_{x:\overline{n|}}&=A_{x+k:\overline{n-k|}}\left(1-\frac{P_{x:\overline{n|}}}{P_{x+k:\overline{n-k|}}}\right)\\
{}^{h}_{k}V^{1}_{x:\overline{n|}}&=A^{1}_{x:\overline{n-k|}}\left(1-\frac{{}_hP^{1}_{x:\overline{n|}}}{{}_hP^{\frac{1}{}}_{x+k:\overline{n-k|}}}\right)\quad\text{for } h<k
\end{aligned}$$

[2/22/2010] On page 573, in Table 28.3, on the line for n-year pure endowment, change ${}_kV^{1}_{x:\overline{n|}}$ to ${}_kV_{x:\overline{n|}}^{\frac{1}{}}$.

[2/9/2010] On page 573, in Table 28.3, on the line for n-year deferred insurance, n premiums, in the second formula, $\ddot{s}_{x:\overline{k|}}$ should be $\ddot{s}_{x:\overline{n|}}$ so that it reads

$$\frac{{}_nP\left({}_{n|}A_x\right)\ddot{s}_{x:\overline{n|}}}{{}_{k-n}E_{x+n}}-{}_{k-n}k_{x+n}\qquad k>n$$

[1/10/2010] On page 577, in Quiz 28-3(i), the 1 should be over the 40: $P^1_{40:\overline{25}|} = 0.08$.

[1/11/2010] On page 579, in exercise 28.8, in (iv), change ${}_{30}\bar{V}_{40}$ to ${}_{30}\bar{V}(\bar{A}_{40})$. On the last line, change ${}_{20}\bar{V}_{40}$ to ${}_{20}\bar{V}(\bar{A}_{40})$ and 40th to 20th.

[3/12/2010] On page 585, in the solution to exercise 28.5, on the third line, change the double-dot on s to a bar.

[2/10/2010] On page 590, in the solution to exercise 28.21, on the second to last line, change $\bar{a}_{50:\overline{10}|}$ to $\bar{a}_{50:\overline{7}|}$.

[1/10/2010] There are several errors in the quiz solutions on page 591. A replacement page is at `MLC9ReplacementPages.pdf`.

[3/5/2010] On page 593, at the end of the second displayed line, change the subscript from $\angle n-k$ to $\overline{n-k}|$.

[4/26/2010] On page 595, in Example 29D(i), change 12.95 to 12.96.

[1/28/2010] On page 596, in Table 29.1, first and third Endowment Insurance lines, change ${}_kV_{x:\angle n}$ to ${}_kV_{x:\overline{n}|}$.

[2/10/2010] On page 608, in the solution to exercise 29.14, on the third displayed line, change B to $\dfrac{B}{1000}$.

[1/28/2010] On page 615, formulas (30.3) and (30.5) are only valid when t is an integer. Thus they would usually be written with the condition $K(x) \geq k$ instead of $T(x) > t$, although for t an integer these two are equivalent.

[3/24/2010] On page 618, in exercise 30.5, while this question is the one that appeared on the old exam, the intended question was " Calculate $\dfrac{\text{Var}\left({}_tL \mid T(x)>t\right)}{\text{Var}\left({}_{t+1}L \mid T(x)>t+1\right)}$ " instead of what is on the last line.

[1/11/2010] On page 619, in exercise 30.11(ii), change $T(x)$ to $T(35)$.

[5/16/2010] On pages 623–624, in the solution to exercise 30.11, all twenty of the unbarred A's should be barred.

[4/26/2010] On page 625, in the solution to exercise 30.21, put bars on the A_{25} in the first and third displayed lines and the A_{50} on the fourth displayed line.

[5/16/2010] On page 630, on the first displayed line, in the numerator, change b_{k+1} to b_{k-1}, and the last subscript on q should be $x+k-2$ instead of $x+k$.

[4/12/2010] On page 631, in exercise 31.4(iii), change ${}_{10}E_x$ to ${}_{10}E_{50}$.

[1/10/2010] On page 652, in Quiz 32-1, add

(v) Premiums are determined by the equivalence principle.

[7/8/2010] On page 654, the solution to Example 32D is incorrect staring with the fourth displayed line. Calculating π is unnecessary. The corrected solution is:

Let's calculate π by setting $k=10$ in equation (32.3), at which point the benefit reserve is 1000.

$$\begin{aligned} 1000 &= (\pi - 1000vq)\ddot{s}_{\overline{10}|} \\ \ddot{s}_{\overline{10}|} &= \frac{1.2^{10}-1}{0.2/1.2} = 31.1504 \\ \pi - \frac{1000(0.03)}{1.2} &= \frac{1000}{31.1504} = 32.1023 \end{aligned}$$

Then the benefit reserve at the end of three years, ${}_3V$, is $(\pi - 30/1.2)\ddot{s}_{\overline{3}|} = 32.1023(4.368)$, and

$$\ddot{s}_{\overline{3}|} = \frac{1.2^3-1}{0.2/1.2} = 4.368$$

$$ {}_3V = 32.1023(4.368) = \boxed{\mathbf{140.22}} $$

[7/8/2010] On page 657, in Table 32.1,

1. On the second line, change $h < k$ to $k < h$.
2. 8 lines from the end, the subtraction sign $-$ before $\beta(m)$ should be changed to an addition sign $+$.

[7/12/2010] On page 658, the solution to Example 32G is incorrect. The correct solution is

We will use formula (32.7), which in this case is

$$ {}_{10}V^{(4)}_{45:\overline{20|}} = {}_{10}V_{45:\overline{20|}} + \beta(4)P^{(4)}_{45:\overline{20|}}\,{}_{10}V^{1}_{45:\overline{20|}} $$

The benefit reserve for an annual premium endowment insurance, ${}_{10}V_{45:\overline{20|}}$, is calculated using the insurance-ratio formula.

$$ {}_{10}V_{45:\overline{20|}} = \frac{0.07 + 0.47 - 0.09 - 0.25}{1 - 0.09 - 0.25} = 0.303030 $$

Based on the tables, $\beta(4) = 0.38424$.

The fractional premium for the endowment insurance, $P^{(4)}_{45:\overline{20|}}$, is

$$ \begin{aligned} A^{(4)}_{45:\overline{20|}} &= \frac{i}{i^{(4)}} A^{1}_{45:\overline{20|}} + A_{45:\overline{20|}^{1}} \\ &= 1.02223(0.09) + 0.25 = 0.342001 \\ \ddot{a}^{(4)}_{45:\overline{20|}} &= \frac{1 - A^{(4)}_{45:\overline{20|}}}{d^{(4)}} = \frac{1 - 0.3475558}{0.05785} = 11.2782 \\ P^{(4)}_{45:\overline{20|}} &= \frac{0.342001}{11.2782} = 0.030324 \end{aligned} $$

The benefit reserve for an annual premium term insurance, ${}_{10}V^{1}_{45:\overline{20|}}$, is

$$ \begin{aligned} \ddot{a}_{55:\overline{10|}} &= \frac{1 - A_{55:\overline{10|}}}{d} = \frac{1 - 0.07 - 0.47}{0.05660} = 8.1272 \\ \ddot{a}_{45:\overline{20|}} &= \frac{1 - A_{45:\overline{20|}}}{d} = \frac{1 - 0.09 - 0.25}{0.05660} = 11.6608 \\ {}_{10}V^{1}_{45:\overline{20|}} &= A^{1}_{55:\overline{10|}} - P^{1}_{45:\overline{20|}}\,\ddot{a}_{55:\overline{10|}} \\ &= 0.07 - \left(\frac{0.09}{11.6608}\right) 8.1272 = 0.007273 \end{aligned} $$

Therefore, the reserve for the fractional premium endowment insurance of this example is

$$ 1000\,{}_{10}V^{(4)}_{45} = 303.030 + (0.38424)(0.030324)(7.273) = \boxed{\mathbf{303.11}} $$

[1/28/2010] On page 661, on the line of Table 32.2 above "Semicontinuous Insurances", on the left, add a b before vq: ${}_kV = (\pi - bvq)\ddot{s}_{\overline{k|}}$. On the right, change $q_x + j - 1$ to q_{x+j-1}.

[1/11/2010] On page 670, the solution to exercise 32.8 is incorrect. The correct solution is

The expected present value of benefits at issue, offsetting -0.01 growth against δ, is

$$ 1000e^{-10(0.02+0.05)}\Big(0.02/(0.02 + 0.05 + 0.01)\Big) = 250e^{-0.7} $$

This is also the expected present value of premiums at issue. The reserve cannot be 0 for $0 < t < 10$ because it increases with premiums and interest and does not decrease with benefits paid. For $t > 10$, the expected present value of future benefits is $250e^{-0.01(t-10)}$ while the expected present value of future premiums is constant, so setting the difference equal to 0:

$$\begin{aligned} 250e^{-0.01(t-10)} - 250e^{-0.7} &= 0 \\ -0.01(t-10) &= -0.7 \\ t &= \boxed{\mathbf{80}} \end{aligned}$$

[11/18/2009] On page 672, in the solution to exercise 32.21, on the first line, change ${}_2V\left(\bar{A}^{1}_{40:\overline{10}|}\right)$ to ${}_2V\left(\bar{A}_{40:\overline{10}|}\right)$ — the term insurance should be an endowment insurance.

[2/24/2010] On pages 674–675, in the solution to exercise 32.26, replace "**Question for you**" until the end of the solution with

Note: You can verify that 6643 is the benefit premium as follows:

$$\begin{aligned} A^{1}_{25:\overline{5}|} &= \frac{a_{\overline{5}|}}{75} = \frac{1-1/1.06^5}{75(0.06)} = 0.056165 \\ A_{25:\overline{5}|}^{\ 1} &= \frac{70}{75}\left(\frac{1}{1.06^5}\right) = 0.697441 \\ A_{25:\overline{5}|} &= 0.056165 + 0.697441 = 0.753606 \\ \ddot{a}_{25:\overline{5}|} &= \frac{1-0.753606}{0.06/1.06} = 4.352964 \\ P(\bar{A}^{1}_{25:\overline{5}|}) &= \frac{(500{,}000)(1.02971)(0.056165)}{4.352964} = 6643 \end{aligned}$$

[1/11/2010] On page 676, the solution to exercise 32.30 is incorrect. The correct solution is

The benefit premium and benefit reserve at the end of 2 years is

$$\begin{aligned} \ddot{a}_{55} &= \sum_{k=0}^{9} \frac{e^{-0.01k}}{1.1^k} + \frac{e^{-0.1}}{1.1}\sum_{k=0}^{\infty}\frac{e^{-0.02k}}{1.1^k} \\ &= \frac{1-(e^{-0.01}/1.1)^{10}}{1-e^{-0.01}/1.1} + \frac{e^{-0.1}}{1.1}\left(\frac{1}{1-e^{-0.02}/1.1}\right) = 9.71754 \\ P_{55} &= \frac{1}{\ddot{a}_{55}} - d = \frac{1}{9.71754} - \frac{0.1}{1.1} = 0.011998 \\ \ddot{a}_{57} &= \sum_{k=0}^{7} \frac{e^{-0.01k}}{1.1^k} + \frac{e^{-0.08}}{1.1}\sum_{k=0}^{\infty}\frac{e^{-0.02k}}{1.1^k} \\ &= \frac{1-(e^{-0.01}/1.1)^{8}}{1-e^{-0.01}/1.1} + \frac{e^{-0.08}}{1.1}\left(\frac{1}{1-e^{-0.02}/1.1}\right) = 9.65026 \\ {}_2V_{55} &= 1 - \frac{9.65026}{9.71754} = 0.006924 \end{aligned}$$

Using recursion, the reserve at the end of 2.5 years is

$$\begin{aligned} {}_{0.5}q_{57} &= 1 - e^{-0.5(0.01)} = 0.004988 \\ {}_{2.5}V_x &= \frac{(0.006924 + 0.011998)(1.1^{0.5}) - 0.004988(1.1^{-0.5})}{1-0.004988} = \boxed{\mathbf{0.015165}} \end{aligned}$$

[1/10/2010] On page 676, the solution to Quiz 32-1 is for the fifth year reserve, rather than the 20th year reserve. Replace it with:

Offset the 0.04 rate of benefit increase against δ, making the adjusted $\delta = 0.02$ The actuarial present value of the insurance is

$$1000\left(\frac{0.02}{0.02+0.02}\right)e^{-(0.06+0.02)5} = 500e^{-0.4}$$

In this equation, the 5-year pure endowment factor uses $\delta = 0.06$ because there is no increase in the benefit in the first 5 years.

Since the equivalence principle is used, the present value of future benefit premiums at issue is also $500e^{-0.4}$. The present value of benefits grows at the rate 0.04, while the present value of premiums grows at the rate 0.02, so after 20 years, the present value of future benefits is $500e^{15(0.04)} = e^{0.6}$ and the present value of future premiums is $500e^{-0.4}e^{20(0.02)} = 500$. The benefit reserve is $500e^{0.6} - 500 =$ **411.06**.

[3/15/2010] On page 680, the line above Example 33B should be changed to the following:

$$\Lambda_j = \begin{cases} -\pi_j + v({}_{j+1}V - {}_jV) & j < K(x) \\ -\pi_j + v(b_{j+1} - {}_jV) & j = K(x) \\ 0 & j > K(x) \end{cases}$$

[3/15/2010] On page 681, in formula (**), change $h+1$ to $k+1$. On the next line, interchange ${}_kV$ and ${}_{k+1}V$. On the following line, interchange b_k and ${}_kV$.

[1/10/2010] On page 682, in Quiz 33-1(iv), delete the words "given that death has not occurred before that time".

[1/10/2010] On page 689, on the last line of the solution to Quiz 33-1, put a big right parenthesis after 57,205, and change 51,221 to 51,899.

[3/1/2010] On page 702, in the solution to exercise 34.5, on the first two displayed lines, remove the line in the presubscripts of p_{xy}.

[11/18/2009] On page 708, on the 11th line, change "to age $x+t$" to "to ages $x+t$ and $y+t$".

[11/18/2009] On page 709, in the solution to Example 35B, 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.

[3/8/2010] On page 720, in the solution to exercise 35.19, on the second displayed line, change the upper bound of the integral from 2 to 3.

[3/9/2010] On page 723, on the first line of the answer to Example 36A, change "joint status" to "last survivor status".

[2/17/2010] On page 724, two lines below equation (36.3), change the + to a −:

$$= \mathring{e}_x - \tfrac{2}{3}\mathring{e}_x^2\mu_y$$

[5/16/2010] On page 726, on the first line of Example 36E, change $1/(100-t)$ to $1/(60-t)$.

[11/18/2009] On page 727, in the answer to Example 36E, on the first displayed line, the integrand on the left is missing a t and should be $t\,{}_tp_{40:40}\,dt$.

[3/18/2010] On page 738, change the last three lines of the solution to Example 37B to

$$\mathbf{E}[0.001Z] = 2(0.24905) - 0.34049 = 0.15761$$
$$\mathbf{E}[(0.001Z)^2] = 2(0.09476) - 0.15641 = 0.03311$$

$$\text{Var}(Z) = 1000^2(0.03311 - 0.15761^2) = \boxed{\mathbf{8269.1}}$$

[2/20/2010] On page 740, in the answer to Example 37E, 0.52652 should be 0.25634 on the two displayed lines. Replace the first displayed line with

$$_{20}E_{45:35} = {}_{20}E_{45}\left(\frac{l_{55}}{l_{35}}\right) = 0.25634\left(\frac{8{,}640{,}861}{9{,}420{,}657}\right) = \boxed{\mathbf{0.23513}}$$

and the second displayed line with

$$_{20}E_{45:35} = {}_{20}E_{45}\,{}_{20}E_{35}(1.06^{20}) = (0.25634)(0.28600)(1.06^{20}) = \boxed{\mathbf{0.23512}}$$

[3/8/2010] On page 750, in the solution to exercise 37.20, on the second displayed line, delete "$1 -$ " on the right hand side.

[11/18/2009] On page 752, in the answer to Example 38B, on the third line, change "an joint-life" to "a joint-life".

[3/22/2010] On page 754, Quiz 38-2 as stated is a difficult contingent survival question. Replace the first sentence with:

An annuity-due on (45) and (55) pays 100 per year until the later of the death of (55) and 30 years from the current date, but does not make any payments while (45) is alive.

[11/18/2009] On page 756, 3 lines before Section 38.4, change the first minus sign to an equals sign:

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

[11/18/2009] On page 778, on the second line of the page, change "probability density function of (40)" to "probability density function of (45)".

[4/20/2010] On page 793, in the solution to exercise 39.15, on the third displayed line, change t^2 to $\frac{1}{2}t^2$.

[3/1/2010] On page 823, exercise 41.23, 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.

[11/18/2009] On page 833, in the answer to Example 42C, 3 lines from the end in the integrand, change ${}_{10}p_x^{(\tau)}$ to ${}_tp_x^{(\tau)}$.

[3/8/2010] On page 842, in the solution to exercise 42.3, on the first and fourth displayed lines, replace $\mu_{(}^{(2)}20)$ with $\mu_{40}^{(2)}(20)$.

[3/8/2010] On page 842, in the solution to exercise 42.4, replace $\mu_{20}^{(\tau)}$ with $\mu_{40}^{(\tau)}(20)$ and $\mu^{(2)}$ with $\mu_{40}^{(2)}(20)$.

[3/22/2010] On page 852, on the last line of the answer to Example 43C, change the numerator's signs so that it reads $3(50-t)(60-t)^2 + 60^3 - (60-t)^3$.

[11/18/2009] On page 870, on the fourth line of Section 44.3, change "illustrate" to "illustrates".

[11/18/2009] On page 889, on the third line of the second paragraph, delete the third word of the line, "the".

[11/18/2009] On page 890, on the sixth displayed line of the page, change the exponent from $-0.02t$ to $-0.14t$ so that it reads

$$= 19{,}000\int_0^{20} e^{-0.14t}\,\mathrm{d}t$$

[4/27/2010] On page 903, in the solution to exercise 45.17, on the third line, change "10-year annuity" to "life annuity".

[3/27/2010] On page 912, the end of first displayed formula is incorrect. Change the formula to

$$G\ddot{a}_x = G(p_r\,\ddot{a}_x + p_f - p_r) + (F+s)A_x + (F/1000)(e_r\ddot{a}_x + e_f - e_r) + f_r\,\ddot{a}_x + f_f - f_r$$

Change the second displayed line to

$$G = \frac{(F+s)A_x + \left((F/1000)e_r + f_r\right)\ddot{a}_x + (F/1000)(e_f - e_r) + f_f - f_r}{\ddot{a}_x - p_r\,\ddot{a}_x - p_f + p_r}$$

[1/29/2010] On page 914, the answer to Example 46B is incorrect. The correct answer is

We will calculate the reserve prospectively.

The data are the same as in Example 46A, so we know that $G = 505.08$. At the fifth duration, the APV of future expenses is $0.1G\ddot{a}_{50:\overline{5}|} + 20\ddot{a}_{50}$, and $\ddot{a}_{50} = (1-0.28)/0.05 = 14.4$, so the APV of future expenses is $0.1(505.08)(4) + 20(14.4) = 490.032$. The expense-loaded reserve is therefore

$$10{,}000A_{50} + 490.032 - 505.08\ddot{a}_{50:\overline{5}|} = 2800 + 490.032 - 505.08(4) = \boxed{\mathbf{1269.712}}$$

[3/27/2010] On page 915, change the first displayed formula in Table 46.1 to

$$G = \frac{(F+s)A_x + \left((F/1000)e_r + f_r\right)\ddot{a}_x + (F/1000)(e_f - e_r) + f_f - f_r}{\ddot{a}_x - p_r\,\ddot{a}_x - p_f + p_r}$$

In the second displayed formula, all subscripts should be changed from x to $x+t$:

$${}_tV^E = (F+s)A_{x+t} + E\ddot{a}_{x+t} - G\ddot{a}_{x+t}$$

[5/13/2010] On page 915, on the last line of Table 46.1 on the right hand side, add a superscript E: ${}_tV^E$.

[1/12/2010] On page 925, replace the last line of the solution to exercise 46.15 with

$$= 52{,}564.61 + 102.3928 - 0.95(4050.05)(10.23928) = \boxed{\mathbf{13{,}270.9}}$$

[1/12/2010] On page 925, the solution to exercise 46.16 is incorrect, because on the first displayed line, G rather than G^e is needed on the right-hand side. The correct solution is

We know that on an exponential-mortality policy the benefit reserve is 0, so we can ignore benefits in this calculation. Therefore, let G^e be the expense loading—not the expense-loaded premium. Since the benefit premium is $10{,}000\mu = 100$, $G = G^e + 100$. By the equivalence principle,

$$\begin{aligned}
G^e\,\bar{a}_{35} &= G(0.5\bar{a}_{35:\overline{1}|} + 0.05\bar{a}_{35}) + 250 + 50\bar{a}_{35} \\
\bar{a}_{35} &= \frac{1}{0.01+0.04} = 20 \\
\bar{a}_{35:\overline{1}|} &= 20(1-e^{-0.05}) = 0.975412 \\
0.5\bar{a}_{35:\overline{1}|} + 0.05\bar{a}_{35} &= 1.487706 \\
20G^e &= (G^e + 100)(1.487706) + 1250 \\
G^e &= \frac{1250 + 148.7706}{20 - 1.487706} = 75.55901
\end{aligned}$$

The expense-loaded reserve at the end of 10 years is

$${}_{10}V^E = (0.05G + 50)\bar{a}_{45} - G^e\,\bar{a}_{45}$$

$$= \Big(0.05(175.55901)+50\Big)(20) - 75.55901(20) = \boxed{\mathbf{-335.621}}$$

If you didn't want to ignore the benefit reserve, you could calculate the expense-loaded premium as

$$\begin{aligned} G\bar{a}_{35} &= \bar{A}_{35} + (0.05\bar{a}_{35} + 0.5\bar{a}_{35:\overline{1}|})G + 250 + 50\bar{a}_{35} \\ \bar{A}_{35} &= 10{,}000\left(\frac{0.01}{0.01+0.04}\right) = 2000 \\ G &= \frac{2000+250+1000}{20-1.487706} = 175.55901 \\ {}_{10}V^E &= \bar{A}_{45} + 50\bar{a}_{45} - 0.95G\ddot{a}_{45} \\ &= 2000 + 1000 - 0.95(175.55901)(20) = \boxed{\mathbf{-335.621}} \end{aligned}$$

Notice that the expense-loaded reserve is constant after the first year.

[1/10/2010] On page 926, replace the last two lines of the solution to Quiz 46-2 with

$$\begin{aligned} 0.98\,{}_1V^E &= (183.23)(1.1) - 2002 = -1800.45 \\ {}_1V^E &= \boxed{\mathbf{-1837.19}} \end{aligned}$$

[5/1/2010] On page 927, replace the end of the answer to Example 47A, "$50 - 62.50 = \boxed{\mathbf{-12.50}}$" with "$62.50 - 50 = \boxed{\mathbf{12.50}}$".

[1/31/2010] On page 930, on the last line, change p_p to p_r.

[1/31/2010] On page 932, on the last line of Table 47.1, change p_p to p_r.

[5/7/2010] On page 947, on the fifth line of the first paragraph, delete the "be" in the parenthetical phrase.

[3/23/2010] On page 948, in Quiz 48-1(iv) and (v), change q_{x+10} to q_{x+9}.

[3/23/2010] On page 949, 5 lines above Quiz 48-2, replace "Alternatively, you could compute..." through the end of the paragraph with

Alternatively, you could compute $\ddot{a}_{x:\overline{20}|}$ using a version of formula (17.7), with constant mortality rate $q_x^{(\tau)} = 1 - e^{-0.05}$:

$$\begin{aligned} \ddot{a}_{x:\overline{20}|} &= (1 - {}_{20}E_x)\,\ddot{a}_x \\ &= (1 - 0.1147065)\left(\frac{1+i}{q+i}\right) \\ &= 0.8852934\left(\frac{1.06}{1.06 - e^{-0.05}}\right) = 8.627435 \end{aligned}$$

and then $\ddot{s}_{x:\overline{20}|} = 8.627435/0.1147065 = 75.2131$.

[5/16/2010] On page 949, 3 lines above Quiz 48-2, change "asset share" to "premium".

[2/3/2010] On page 951, in the second formula of Table 48.1, change $p_f - p_r$ to $p_r - p_f$. On the last line of Table 48.1, change 911 to 912. The notation that is defined on page 912 is p_f and p_r. p_f and p_r have the same meaning as c_f and c_r.

[3/24/2010] On page 952, in exercise 48.2(v), change the heading of the third column, "Asset share at time $k+1$", to "Asset share at time k".

[3/31/2010] On page 953, in exercise 48.6, in the table, change "Cash Value at Time k" to "Cash Value at Time $k+1$".

[1/5/2010] On page 982, in the solution to Quiz 49-1, in the last column of the transition probability matrix, change both 0.1's to 0.01's in both places (2nd line, 5th line), so that the matrix is

$$\begin{pmatrix} 0.9 & 0.09 & 0.01 \\ 0.3 & 0.69 & 0.01 \\ 0 & 0 & 1 \end{pmatrix}$$

Change the last sentence to

The probability of paying the fourth premium is $0.9(0.837)+0.3(0.1431)=$ **0.79623**.

[1/31/2010] On page 984, in footnote 1, change ${}_n v_t$ to ${}_t v_n$.

[5/16/2010] On page 986, on the second line of the third paragraph of Section 50.3, change ${}_t C^{(i,j)}$ to ${}_{t+1} C^{(i,j)}$.

[4/1/2010] On page 986, on the last line of the page, change "begin" to "being".

[11/18/2009] On page 1003, 9 lines from the bottom of the page, change "variables" to "variable".

[11/18/2009] On page 1004, on the fourth line of the answer to Example 51B, change "number" to "numbers".

[1/11/2010] On page 1006, on the first line, change "sot" to "so that".

[4/21/2010] On page 1006, on the first line of Example 51H, add after "answering center": "in a nonhomogeneous Poisson process".

[11/18/2009] On page 1007, the caption of Figure 51.1 should refer to Example 51H instead of 51G.

[1/11/2010] On page 1007, in Quiz 51-2, change "December 1 to May 31" to "June 1 to November 30".

[4/21/2010] On page 1010, in exercise 51.13, add after "amount of time" the words "in hours".

[1/11/2010] On page 1015, the solution to Quiz 51-2 is incorrect. The correct solution is

The mean number of tropical storms for a season is

$$m(0.5)=\int_0^{0.5}(24t-48t^2)\mathrm{d}t=12t^2-\frac{48t^3}{3}\bigg|_0^{0.5}=1$$

We would like n such that $\sum_{i=0}^{n} p_n > 0.9$, or $e^1\sum_{i=0}^{n} p_n > 0.9e = 2.4465$. Summing up ep_n:

$$1+1+0.5=2.5$$

so $n=$ **2** is the smallest number for which the probability of n or fewer hurricanes is greater than 90%.

[11/18/2009] On page 1017, on the second line from the bottom of the page, add "$\mathrm{d}u$" at the end.

[5/4/2010] On page 1022, in the solution to Quiz 52-2, on the first line, change the exponent on e from $e^{-0.06}$ to $e^{-0.06t}$.

[4/3/2010] On page 1026, on the first displayed line, add a set of parentheses around the second case: $\big(5/(20-t)\big)^2$.

[4/6/2010] On page 1037, change the first half of the sentence beginning 6 lines above Example 54B to

If $Y(t)=X_1(t)-X_2(t)$ with $X_1(t)$ and $X_2(t)$ independent, then the mean of $Y(t)$ is the difference of the means of $X_1(t)$ and $X_2(t)$, or $\mathbf{E}[X_1(t)]-\mathbf{E}[X_2(t)]$, but the variance of $Y(t)$ is the sum of the variances of $X_1(t)$ and $X_2(t)$, or $\mathrm{Var}\big(X_1(t)\big)+\mathrm{Var}\big(X_2(t)\big)$, since ...

[4/6/2010] On page 1039, 2 lines from the bottom, change 1/2 to 1/12.

[4/3/2010] On page 1041, replace the last line of the answer to Example 54F with

$$= 1 - 0.102385 - 0.213301 - 0.239964 = \boxed{\mathbf{0.444351}}$$

[4/6/2010] On page 1042, in Table 54.1, 3 lines from the end, change p_n to p_k.

[5/16/2010] On page 1044, in exercise 54.12, on the second line, delete the word "submitted".

[5/16/2010] On page 1060, in the solution to exercise 55.13, on the displayed line, add $1 -$ at the beginning.

[1/6/2010] On page 1068, in question 3(ii), change snnual to annual.

[5/7/2010] On page 1080, in question 21, one line below the table, add the word "curtate" before "future lifetime".

[3/14/2010] On page 1085, in question 4(iv), change 2067.28 to 1777.98.

[4/18/2010] On page 1125, question 19 is defective.

[12/5/2009] On page 1125, in question 22, add:

(iii) The number of scientists eaten by each allosaur is a Poisson process.

[11/18/2009] On page 1148, in the solution to question 5, on the first displayed line, A_{x+10} should be $\bar{A}_{x+10}$. Six lines further down, on the third displayed line, $e^{-10(\delta-\delta')}$ should be $e^{-10(\mu+\delta-\delta')}$.

[4/17/2010] On page 1149, in the solution to question 6, replace the third displayed line with

$$= \int_0^3 \left(1 - \left(\frac{t}{20}\right)^2\right) \mathrm{d}t$$

[4/26/2010] On page 1152, in the solution to question 18, replace $\overline{10-x|}$ with $\overline{40-x|}$ in all the displayed equations (twice in the first, twice in the third, once apiece in the fourth and fifth) and $\overline{9-x|}$ with $\overline{39-x|}$ in the 3rd (twice), 4th (once), and 5th (once) displayed equations.

[4/26/2010] On page 1163, in the solution to question 23, on the third displayed line, change $e^{-0.5}$ to $1-e^{-0.5}$. On the fourth displayed line, change $e^{-0.8}$ to $1-e^{-0.8}$. On the last line, replace 0.137668 with 0.157388.

[3/14/2010] On page 1167, the solution to question 4 is incorrect. The correct solution is

By the equivalence principle,

$$\begin{aligned} G(0.9\ddot{a}_{45:\overline{30}|} - 0.3) &= 100{,}100A_{45} + ra_{45} + 200 \\ 1000A_{45} &= 201.2 \\ a_{45} &= 14.1121 - 1 = 13.1121 \\ \ddot{a}_{45:\overline{30}|} &= \ddot{a}_{45} - {}_{30}E_{45}\,\ddot{a}_{75} \\ &= 14.1121 - (0.52652)(0.19472)(7.2170) = 13.3722 \end{aligned}$$

where we evaluated ${}_{30}E_{45} = {}_{10}E_{45}\,{}_{20}E_{55}$.

$$\begin{aligned} 0.9\ddot{a}_{45:\overline{30}|} - 0.3 &= 11.73499 \\ 11.73499(1777.98) &= 100.1(210.2) + 13.1121r + 200 \\ r &= \frac{11.73499(1177.98) - 100.1(201.2) - 200}{13.1121} = \boxed{\mathbf{40}} \end{aligned}$$

(A)

[5/13/2010] On page 1171, on the third line of the solution to question 19, change $0.994081.05^2$ to $\dfrac{0.99408}{1.05^2}$.

[11/18/2009] On page 1172, in the solution to question 21, on the third line, change "Waiting time for 4 services" to "Waiting time for 5 services".

[12/5/2009] Page 1186–1195 are the solutions to Practice Exam 6, not Practice Exam 5. Replacements for these 10 pages are at `MLC9ReplacementPages.pdf`. (The pages are correct in the second printing.)

[5/9/2010] On page 1192 of the second printing, or of the replacement pages, the last two lines of the solution to question 20 should read

$$\begin{aligned}\Lambda_4 &= -P_{50} + \frac{{}_5V_{50} - {}_4V_{50}}{1.05} \\ &= -0.027386 + \frac{0.047034 - 0.037139}{1.05} = \boxed{\mathbf{-0.01796}}\end{aligned}$$

[4/25/2010] On page 1218, in the solution to question 2, change the first displayed line to

$$75(\bar{a}_x + \bar{a}_y) - 50\bar{a}_{xy}$$

Change the final answer to **(B)**, both in the question and in the answer key table.

[4/27/2010] On page 1222, the solution to question 15 is incorrect. The correct solution is The probability of death from accidental causes is the ratio of the μ's, or $0.01/(0.01+0.02) = 1/3$, so the median is less than 1000. By the Law of Total Probability,

$$\begin{aligned}\Pr(Z<x) &= \Pr(Z<x \mid \text{accident})\Pr(\text{accident}) + \Pr(Z<x \mid \text{other})\Pr(\text{other}) \\ &= \frac{1}{3}\Pr(Z<x \mid \text{accident}) + \frac{2}{3}\Pr(Z<x \mid \text{other}) \qquad (*)\end{aligned}$$

The probability of accidental death before time t is

$$\begin{aligned}{}_tq_x^{(1)} &= \int_0^t {}_up_x^{(\tau)}\mu_{x+u}^{(1)}\,\mathrm{d}u \\ &= \int_0^t e^{-0.03u}0.01\,\mathrm{d}u = \frac{1-e^{-0.03t}}{3}\end{aligned}$$

and similarly, the probability of nonaccidental death before time t is $\frac{2}{3}(1-e^{-0.03t})$. It follows that the conditional probability of accidental death before time t given that death is accidental is

$$\frac{(1-e^{-0.03t})/3}{1/3} = 1-e^{-0.03t}$$

so that the conditional probability of accidental death after time t given that death is accidental is $e^{-0.03t}$. Similarly the conditional probability of nonaccidental death after time t given that death is nonaccidental is $e^{-0.03t}$. Both conditional probabilities are equivalent to a single-decrement force of 0.03. It follows that the probability of $Z<x$ given accidental death is, for $x \le 2000$,

$$\Pr(Z<x \mid \text{accident}) = \Pr(2000e^{-0.05T} < x \mid \text{accident}) = \Pr\left(e^{-0.05T} < \frac{x}{2000}\right) = \left(\frac{x}{2000}\right)^{3/5}$$

and similarly, the probability of $Z<x$ given nonaccidental death, for $x \le 1000$, is $(x/1000)^{3/5}$. Plugging into (*),

$$\Pr(Z<x) = \frac{1}{3}\left(\frac{x}{2000}\right)^{3/5} + \frac{2}{3}\left(\frac{x}{1000}\right)^{3/5} = \left(\frac{1}{3}(0.5)^{3/5} + \frac{2}{3}\right)\left(\frac{x}{1000}\right)^{3/5}$$

Set this equal to 0.5 to solve for the median.

$$\left(\frac{1}{3}(0.5)^{3/5}+\frac{2}{3}\right)\left(\frac{x}{1000}\right)^{3/5}=0.5$$
$$0.886585\left(\frac{x}{1000}\right)^{3/5}=0.5$$
$$\left(\frac{x}{1000}\right)^{3/5}=\frac{0.5}{0.886585}=0.563962$$
$$x=1000(0.563962)^{5/3}=\boxed{\textbf{384.96}} \qquad \textbf{(D)}$$

[4/18/2010] On page 1224, the solution to question 19 is incorrect. Solving the question requires more calculations than a reasonable exam question could have.

[2/21/2010] On page 1291, in the solution to question 24, on the first displayed line change $p_{61}^{(\tau)}$ to $p_{60}^{(\tau)}$. On the second displayed line, change $p_{62}^{(\tau)}$ to $p_{61}^{(\tau)}$.

[12/2/2009] On page 1322, the solution to question 1 is incorrect. The correct solution is

Assume that the worker's birthday is not December 31. The worker has just turned 55 in year x. In year $x+4$, the worker will turn 59. We want to know the probability that the worker retires on December 31 of years $x+4$, $x+5$, or $x+6$. The probability that the worker does not retire by year $x+4$ is l_{59}/l_{55}, and the probability that the worker does not retire by year $x+7$ is l_{62}/l_{55}, so the probability that the worker retires on December 31 of years $x+4$, $x+5$, or $x+6$ is $(l_{59}-l_{62})/l_{55}$.

$$l_{59}=1000-4^3$$
$$l_{62}=1000-7^3$$
$$\frac{l_{62}-l_{59}}{l_{55}}=\frac{7^3-4^3}{1000}=\boxed{\textbf{0.279}} \qquad \textbf{(E)}$$

The answer is far out of the range. Apparently the question writers mistakenly calculated $(l_{61}-l_{58})/l_{55}=0.189$ and thought the answer was (C), and in fact the preliminary answer was (C).