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

[7/2/2009] On page xii, on the last line of the fourth paragraph of "Tables", change 0.8859 to 0.8860.

[8/4/2009] On page 6, in Section 1.3, $\Pr(B) \neq 0$ and $f(y) \neq 0$ are necessary for the definitions of conditional probability.

[7/7/2008] On page 8 in Table 1.1 on the Weibull row for $f(x)$, the negative sign in the exponent of e should be outside the parenthesis: $e^{-(x/\theta)^\tau}$.

[1/20/2009] On page 16, in the solution to exercise 1.12, 3 lines from the end, change the denominator x to m.

[7/9/2009] On page 16, in the solution to exercise 1.14, on the 7th line, change $g(x)$ to $g(n)$.

[8/4/2009] On page 20, one line after Example 2A, add the word "independent": "... from n independent identically distributed ...".

[8/31/2009] On page 32, in the solution to exercise 2.14, on the second line from the end, delete a plus sign between 0.0064 and 0.183125.

[6/11/2009] On page 43, in the solution to exercise 3.6, on the third line, replace David with Dick.

[7/13/2009] On page 43, in the solution to exercise 3.8, on the displayed line, change the subscript $x + t$ to $x + 5$.

[7/13/2009] On page 44, in the solution to exercise 3.9, on the 4th displayed line, replace the denominator vw with uv. Replace 0.948574 with 0.948514 on the third from last line and the last line.

[8/31/2009] On page 46, 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, ${}_tp_x = (65 + x)/(65 + x + t)$.

[8/31/2009] On page 53, in exercise 4.21, on the third line, change q_x to q_{30}.

[8/2/2009] On page 62, in the solution to exercise 4.34, put a negative sign before the integral in the first and second displayed lines.

[2/14/2009] On page 89, in the solution to exercise 6.23, on the seventh displayed line, change $\text{Var}(T(30 \wedge 30)$ to $\text{Var}(T(30 \wedge 10)$.

[7/13/2008] On page 105, in the solution to exercise 7.11, on the 4th displayed line, e_x should be e'_x.

[7/14/2009] On page 108, in the solution to exercise 7.24, on the third line from the end, change $+\dfrac{0.6931}{2}$ to $-\dfrac{0.6931}{2}$.

[9/7/2008] On page 115, in the solution to Example 8E, on the second line, replace 0.9^k with 0.99^k.

[12/29/2008] On page 119, on the 7th and 8th lines, replace 0.471132 with 0.447576.

[9/3/2009] On page 119, on the third line of the answer to Example 8J part 2, add ds after the left hand side integral.

[7/2/2009] On page 132, in the solution to exercise 8.11, on the second line from the end, change $1 - 0.5(0.6)$ to $1 - 0.5(0.06)$.

[9/7/2008] On page 132, in the solution to exercise 8.12, delete one of the "Group"'s in the first column of the table.

[9/3/2009] On page 132, in the solution to exercise 8.12, 4 lines from the end, delete one of the 1's after "are".

[9/3/2009] On page 132, in the solution to exercise 8.13, on the last line of the page, the left hand side should be $\mathbf{E}[T^2 \wedge 2]$.

[7/14/2009] On page 133, in the solution to exercise 8.14, the page reference should be page 115, not page 8.7.

[7/14/2009] On page 134, in the solution to exercise 8.18, on the fourth displayed line, $\frac{5}{24}$ should be $-\frac{5}{24}$.

[7/7/2009] On page 134, in the graph for the solution to exercise 8.19, change l_x to ${}_{x-20}p_{20}$.

[8/20/2009] On page 138, in the solution to exercise 8.37, in II, change the numerator from 13 to $\frac{1}{3}$.

[7/8/2009] On page 139, in the solution to exercise 8.39, on the second displayed line, change ${}_{2|0.5}q_{x+2}$ to ${}_{2|0.5}q_x$.

[7/15/2009] On page 143, on the first 2 displayed lines of the page, change 9,683,267 to 9,683,297.

[7/15/2009] On page 154, in the solution to exercise 9.9, on the fifth line, change l_{98} to q_{98}.

[7/2/2009] On pages 159–201, change "actuarial present value" to "present value" in:

- Section 10.1, third paragraph, third sentence.
- Solution to exercise 11.22, first sentence.
- Solution to exercise 11.23, first sentence.

[9/7/2008] On page 166, in exercise 10.9, replace all 7 λ's with δ's.

[8/8/2009] On page 173, in the solution to exercise 10.7, 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 δ. 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 μ. For $\bar{a}_x$, adding a constant to μ results in a lower value, since $\bar{a}_x = \int_0^\infty v^t \, {}_tp_x \, dt$, and adding a constant to μ lowers ${}_tp_x$. 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 173, in the solution to exercise 10.8, on the second line, change $e^{-1.6}$ to $100{,}000e^{-1.6}$.

[9/9/2009] On pages 174–175, the solution to exercise 10.13 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

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

[7/16/2009] On page 178 in the solution to exercise 10.27, on the last line, remove the second of the three minus signs; $(7/3)^2$ should be multiplied by the parenthesized expression.

[9/9/2009] On page 194, in the solution to exercise 11.5, on the fourth line, change "interest rate" to "force of interest".

[3/24/2009] On page 195, in the solution to exercise 11.7, on the 7th line of the page, there should be a negative sign before the expression:

$$= -\left(\frac{0.02}{0.1}\right)\left(\frac{1}{1 + 0.1t}\right)\Bigg|_0^{50}$$

[7/17/2009] On page 198, in the solution to exercise 11.15, on the 3rd line of the page, change $\frac{4}{15}$ to $\frac{4}{14}$.

[7/20/2008] On page 203, in the boldfaced line, replace $1 - 100p^{\text{th}}$ with $100(1-p)^{\text{th}}$.

[7/20/2008] On page 210, in the solution to exercise 12.1, replace the last expression (starting after "which is") with $1 - e^{-0.01(10)-0.02(20)} = 1 - e^{-0.5} = \boxed{\mathbf{0.3935}}$.

[7/17/2009] On page 210 in the solution to exercise 12.3, on the 6th line, replace the second sentence with

We want $\Pr\left(1.864707e^{-0.06T} > 0.5\right)$, or $\Pr\left(e^{-0.06T} > 0.5/1.864707\right)$ and $0.5/1.864707 = 0.268139$, or $\Pr(T < -\ln 0.268139/0.06)$, and $-\ln 0.268139/.06 == 21.9375$.

[7/21/2008] On page 211, in the solution to exercise 12.5:

- On the second and third lines, reverse the inequalities: $1.06^{-T(35)} > 0.7$ and $1.06^{-T(35)} > 0.35$.
- On the second line from the end, change $l_{35} +$ to $l_{35} =$.
- On the last two lines, change 9,184,051 to 9,164,051, which affects the final answer. The last line should read

$$1 + \frac{-9{,}283{,}908 + 9{,}164{,}051 - 8{,}778{,}004}{9{,}420{,}657} = \boxed{\mathbf{0.05549}}$$

[7/21/2008] On page 211, in the solution to exercise 12.6, remove the gray box around the final 0.9543 and add the following line:

So $\Pr(T(35)) < 14.2067 = {}_{14.2067}q_{35} = 1 - 0.9543 = \boxed{\mathbf{0.0457}}$.

[9/9/2009] On page 212, in the solution to exercise 12.10, on the first line, replace λ with δ.

[7/21/2008] On page 213, the last 2 lines of the solution to exercise 12.13 are incorrect. The correct lines are

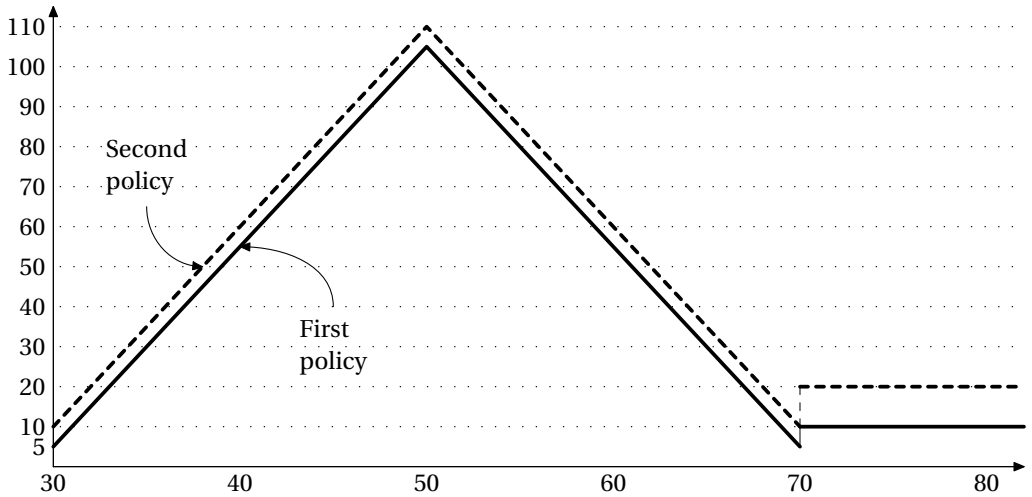
$$t = 60(0.4) = 24$$

The value of Z is $(40 - 24)e^{-24(0.05)} = \boxed{\mathbf{4.8191}}$.

[7/21/2008] On page 216, in the solution to exercise 12.22, replace the final answer of 1.5125 with $e^{1.5125} = 4.5380$.

[9/9/2009] On page 230, in exercise 13.36, on the second line after the table, add "age 49" at the end of the sentence after "100 lives".

[3/4/2009] On page 235, Figure 13.1 is incorrect. The correct figure is



[7/19/2009] On page 239, in the solution to exercise 13.34, on the second line from the end, change 0.21546 to 0.021546.

[7/20/2009] On page 242, change the third sentence of Section 14.2 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.

[3/10/2009] On page 252, the solution to exercise 14.2 is incorrect. The correct solution is

The benefit premium is

$$10{,}000A_{63} = \frac{5233}{1.12} = 4672.32,$$

so $A_{63} = 0.467232$. We use the equation

$$A_{63} = vq_{63} + v^2 p_{63}\, q_{64} + v^2\, {}_2p_{63}\, A_{65}$$

and the values of $q_{63} = 0.01788$, $q_{64} = 0.01952$, $l_{63} = 7{,}823{,}879$, $l_{65} = 7{,}533{,}984$ to obtain:

$$\begin{aligned}
{}_2p_{63} &= \frac{l_{65}}{l_{63}} = \frac{7{,}533{,}984}{7{,}823{,}879} = 0.962947 \\
0.467232 &= \frac{0.01788}{1.05} + \frac{(1 - 0.01788)(0.01952)}{1.05^2} + \frac{0.962947}{1.05^2} A_{65} \\
0.467232 &= 0.017029 + 0.017389 + 0.873422 A_{65} \\
A_{65} &= \frac{0.467232 - 0.017029 - 0.017389}{0.873422} = 0.49554
\end{aligned}$$

The contract premium at 65 is $1.12(10{,}000)(0.49554) = 5550$. The earnings rate needed is $\left(\frac{5550}{5233}\right)^{1/2} - 1 =$ $\boxed{\mathbf{0.030}}$. **(A)**

[7/27/2009] On page 256, in the solution to exercise 14.23, on the first line, change vq_{50} to $1000vq_{50}$.

[7/21/2009] On page 264, in the solution to exercise 15.3, delete the half-sentence "We calculate ... formula".

[7/21/2009] On page 264, in the solution to exercise 15.4, on the sixth line, change ${}^2_{10}E38$ to ${}^2_{10}E_{38}$.

[2/23/2009] On page 267, on the second line of the third paragraph, change "present variable" to "present value".

[7/13/2008] On page 276, on the last line, SOA MLC-S07:24 belongs to lesson 17.

[9/15/2009] On page 279, in the solution to exercise 16.7, on the 6th line, replace 0.09 + 0.3 = 0.09 with 0.09 + 0.03 = 0.12.

[1/15/2009] On page 284, on the last line of the solution to Example 17B, replace ${}_{30|}\ddot{a}_{35}$ with $\ddot{a}_{35:\overline{30|}}$.

[9/9/2009] On page 305, in the solution to exercise 17.14, the last line should read

$$ia_{x:\overline{n|}} + (1+i)A_{x:\overline{n|}} - 1 = 1 + i - i + i\,{}_nE_x - 1 = \boxed{\boldsymbol{i\,{}_nE_x}} \qquad \textbf{(B)}$$

[10/22/2008] On page 313, in the paragraph before Example 18A, it is stated that all the formulas can be used for annuities-due by replacing δ with d. Actually, in the last formula, ${}^2\bar{A}_x = 1 - (2\delta)\,{}^2\bar{a}_x$, 2δ should be replaced with d at twice the force of interest, which is $2d - d^2$.

[7/24/2009] On page 313, in equation (18.6), replace $\ddot{a}_{\overline{T(x)|}}$ with $\ddot{a}_{\overline{K(x)+1|}}$.

[7/26/2009] On page 314, on the 12th line under "Variance of a deferred annuity", replace $\mathrm{Var}(Y \mid I)$ with $\mathrm{Var}_I(\mathbf{E}[Y \mid I])$.

[8/6/2009] On page 316, on the last line of the page, (-1266.67^2) should be $(-1266.67)^2$.

[7/24/2009] On page 319, in exercise 18.6, change "continous" to "continuous whole"

[9/9/2009] On page 324, in the solution to exercise 18.2, on the second displayed line, move the double-dot off the E to $a_{x:\overline{30|}}$.

[9/9/2009] On page 326, in the solution to exercise 18.9, on the fourth line, change ${}_tq_{30}$ to ${}_{t|}q_{30}$.

[7/14/2008] On page 342, in exercise 19.31, on the fifth line, change "the" to "then".

[8/6/2009] On page 344, in the solution to exercise 19.6, on the last line, remove the minus sign from the exponent.

[7/26/2009] On page 347, in the solution to exercise 19.16, 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 $\dfrac{e^{-1.2}}{0.08}$.

[3/31/2009] On page 350, in the solution to exercise 19.31, on lines 5, 4, and 3 from the bottom of the page, change ${}_{9|}\ddot{a}_x$ to ${}_{9|}\ddot{a}_{x+1}$.

[9/15/2009] On page 351, in the solution to exercise 19.32, on the last line, replace $u(65)$ with $u(64)$.

[9/7/2008] On page 357, in exercise 20.15, on the first line, change (45) to (50). Also, on the fourth line, add at the end of the sentence "with uniform distribution of deaths between integral ages."

[7/26/2009] On page 358, in the solution to exercise 20.5, on the third and fourth lines, replace 0.095897 by 0.0956897, once on each line.

[9/15/2009] On page 360, in the solution to exercise 20.14, on the first displayed line, interchange $\bar{A}_{70}$ and A_{70}.

[9/7/2008] On page 360, the solution to exercise 20.15 is incorrect, both because of an arithmetic error on the 5th line and because the semi-annual annuity is for 8 annually, not 4 annually. A corrected solution, with an alternative method, is as follows:

Here are two methods for solving this.

One method is to calculate $10a_{50} + 4\,{}_{0.5|}\ddot{a}_{50}$, where the symbol ${}_{0.5|}\ddot{a}_{50}$ is used to indicate the actuarial present value at age 50 of payments of 1 at age 50.5, 51.5, 52.5, ... (I'm not sure this is the standard meaning of the symbol.) $a_{50} = \ddot{a}_{50} - 1 = 13.2668 - 1 = 12.2668$ from the Illustrative Life Table, while

$$\begin{aligned} {}_{0.5|}\ddot{a}_{50} &= \sum_{t=0}^{\infty} v^{t+0.5}\,\frac{l_{50.5+t}}{l_{50}} \\ &= v^{0.5}\sum_{t=0}^{\infty} v^{t}\,\frac{l_{50.5+t}}{l_{50}} \end{aligned}$$

By uniform distribution of deaths, $l_{50.5+t} = (l_{50+t} + l_{51+t})/2$, so

$$\begin{aligned}
{}_{0.5|}\ddot{a}_{50} &= \frac{v^{0.5}}{2}\sum_{t=0}^{\infty} v^t\left(\frac{l_{50+t}}{l_{50}} + \frac{l_{51+t}}{l_{50}}\right)\\
&= \frac{v^{0.5}}{2}\left(\ddot{a}_{50} + (1+i)\sum_{t=0}^{\infty} v^{t+1}\frac{l_{51+t}}{l_{50}}\right)\\
&= \frac{v^{0.5}}{2}\left(\ddot{a}_{50} + (1+i)\sum_{t=1}^{\infty} v^{t}\frac{l_{50+t}}{l_{50}}\right)\\
&= \frac{v^{0.5}}{2}[\ddot{a}_{50} + (1+i)a_{50}]\\
&= \frac{1}{2(1.06^{0.5})}[13.2668 + 1.06(12.2668)]\\
&= 0.485643(13.2668 + 13.0028) = 12.7576
\end{aligned}$$

The APV of the annuity is then $10(12.2668) + 4(12.7576) =$ **173.6986**.

Another method is to calculate $6a_{50} + 8a^{(2)}_{50}$, since the payments can be looked at as an annual life annuity-immediate of 6 per year plus a semi-annual life annuity-immediate of 8 per year (or 4 per half-year).

$$\begin{aligned}
a_{50} &= \ddot{a}_{50} - 1 = 13.2668 - 1 = 12.2668\\
a^{(2)}_{50} &= \ddot{a}^{(2)}_{50} - 0.5\\
&= \alpha(2)\ddot{a}_{50} - \beta(2) - 0.5\\
&= 1.00021(13.2668) - 0.25739 - 0.5 = 12.5122\\
6(12.2668) &+ 8(12.5122) = \mathbf{173.6984}
\end{aligned}$$

The slight difference in answers is due to rounding.

[9/23/2009] On page 377, in exercise 22.3, on the first line, change fullY to fully.

[1/24/2009] On page 383, the information in the box at the top should be used for questions 22.20–22.23 (not just for 22.20 and 22.21).

[7/28/2009] On page 392, in the solution to exercise 22.1, 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 393, in the solution to exercise 22.3, 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 395, in the solution to exercise 22.7, on the last line, the denominator should be 14, not 13.236242.

[7/28/2009] On page 395, in the solution to exercise 22.9, on the third displayed line, the denominator should be 40(0.05) instead of 40.

[9/23/2009] On page 400, in the solution to exercise 22.25, on the 6th and 8th lines, put double-dots on the three a's that don't have them.

[7/28/2009] On page 406, replace the last line of the solution to exercise 22.49 with

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

[4/3/2009] On page 408, in the solution to exercise 22.53, move the right parenthesis of the second line past d:

$${}_{15}E_{30}\left(d + \frac{1}{\ddot{a}_{30:\overline{15}|}} - d\right) = \frac{1}{\ddot{s}_{30:\overline{15}|}}$$

[7/31/2009] On page 409, on the last line of Example 23A, delete the word "benefit".

[10/29/2008] On page 409, on the first line of the answer to Example 23A, change "25th" to "75th".

[8/2/2009] On page 413, the solution to exercise 23.7 should read

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

[8/2/2009] On page 425, in the solution to exercise 24.16, on the fifth line from the bottom of the page, change "v^T otherwise" to "v^n otherwise".

[7/29/2009] On page 436, in the solution to exercise 25.7, on the fourth displayed line, the line should end with 1.7763, and $\dfrac{P}{d} = 0.7763$ should be placed a separate line.

[9/23/2009] On page 437, in the solution to exercise 25.11, replace the third displayed line with

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

[8/17/2009] On page 441, in the solution to Example 26A:

- Change $A_{60} - {}_{20}E_{60}A_{80}$ to $1000A_{60} - 1000\,{}_{20}E_{60}\,A_{80}$ on the first displayed line.
- Change $\bar{A}_{60:\overline{20}|}$ to $1000\bar{A}_{60:\overline{20}|}$ on the last displayed line.

[8/3/2009] On page 449, on the fourth line of the second paragraph, delete the word "benefit".

[9/23/2009] On page 451, in the answer to Example 27C part 2 two lines from the end, change ${}^{20}_{15}V_x$ to ${}^{20}_{15}V_{40}$.

[3/24/2009] On page 459, in the solution to exercise 27.9, on the second to last line, change "end of the third year" to "end of the second year".

[8/3/2009] On page 460, in the solution to exercise 27.12, on the 4th displayed line, change 0.46587 to 0.046587.

[4/12/2009] On page 473, in the solution to exercise 28.3, on the third line, change "present value of future benefits" to "present value of future premiums".

[3/1/2009] On page 475, in the solution to exercise 28.7, on the third line, replace ${}_{15}\ddot{a}_{10:\overline{30}|}$ with ${}_{15|}\ddot{a}_{10:\overline{30}|}$.

[3/1/2009] On page 475, in the solution to exercise 28.8, "the insurance formula" refers to the insurance-ratio formula, equation (29.2).

[8/3/2009] On page 477, in the solution to exercise 28.17, on the 4th line, change ${}^{(2)}_{V}$ to ${}_tV^{(2)}$.

[8/4/2009] On page 493, in the solution to exercise 29.6, on the displayed line, change the ${}_t\bar{V}(\bar{A}_{x+t})$ to ${}_t\bar{V}(\bar{A}_x)$

[8/4/2009] On page 495, in the solution to exercise 29.17, on the last line, change ${}_{20}V_{35}$ to ${}_{20}V_{25}$.

[8/4/2009] On page 495, in the solution to exercise 29.18, on the second line from the end, change $1 - 0.1(0.4)$ to $1 - 0.1(4)$.

[9/23/2009] On page 496, in the solution to exercise 29.24, on the first displayed line, change P_x to P_{36}.

[10/27/2009] On page 499, in the first displayed formula, replace $\text{Var}({}_tL \mid T(x) \geq t)$ with $\text{Var}({}_tL \mid T(x) > t)$.

[3/3/2009] On page 505, in the solution to exercise 30.2, on the first line, there should be a bar over the A.

[8/5/2009] On page 524, in the solution to exercise 31.15, 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 525, in the solution to exercise 31.17, on the first displayed line, change A_{x+20} to $1000A_{x+20}$.

[9/23/2009] On page 531, two lines from the bottom of the page, delete one of the two consecutive "the"'s

[9/23/2009] On page 533, on the second line of the answer to Example 32C, replace q_{x_t-1} with q_{x+t-1}.

[8/9/2009] On page 543, in exercise'32.24, on the last line, change "understates" to "overstates".

[9/23/2009] On page 582, in the solution to exercise 35.11, change all eleven x's to t's.

[2/14/2009] On page 584, in the solution to exercise 35.15, on the first line of the page, put negative signs in both numerators so it reads

$$= \frac{1}{5250}\left(\frac{-(75-x)^3}{3}\bigg|_0^{70} - \frac{-5(75-x)^2}{2}\bigg|_0^{70}\right)$$

[7/20/2008] On page 601, on the 2nd and 4th lines of the page, change 7.142957 to 7.142857.

[10/6/2009] On page 610, in the solution to exercise 37.15, three lines from the end, replace the subscript $\overline{y:y} : \overline{n}|$ with $\overline{y:y} : \overline{10}|$.

[9/25/2009] On page 612, in the solution to exercise 37.22, on the seventh line, $30E_{20}$ should be ${}_{30}E_{20}$.

[10/6/2009] On page 650, in the solution to exercise 40.13, on the first line, replace "voluntarily" with "leaving voluntarily in the second year".

[4/19/2009] On page 660, in the solution to exercise 41.2, on the second line, change $0.2k^{-0.8t}$ to $0.2ke^{-0.8t}$.

[5/7/2009] On page 662, in the solution to exercise 41.15, on the third displayed line, move the subscript x on the (τ) in the exponent to p: ${}_tp_x^{(\tau)}$.

[5/7/2009] On page 664, in the solution to exercise 41.21, on the last line, move the exponent outside the parentheses into the denominator and remove the parentheses:

$$\frac{6{,}616{,}155^2 - 6{,}396{,}609^2}{8{,}188{,}073^2}$$

[5/10/2009] On page 679, in exercise 42.30, add the word "calendar" before "year" in (i), (ii), and (iii).

[10/6/2009] In the solution to exercise 42.27, in the first displayed formula on the page, $\mu_{64}(t)$ should be $\mu_{64}^{(1)}(t)$.

[5/10/2009] On pages 690–691, the solution to exercise 42.30 is incorrect. While the calculation of ${}_{0.25}q_{x+0.25}^{(2)}$ is correct, the calculation of ${}_{0.25}q_{x+0.5}^{(2)}$ incorrectly divides by ${}_{0.5}p_x^{(\tau)}$ instead of by ${}_{0.25}p_{x+0.25}^{(\tau)}$. In any case, the solution is too complicated. A simpler solution is:

Number the decrements with the question's item numbers, (1), (2), and (3). We need ${}_{0.5}q^{(2)}_{x+0.25}$, since the decrements are uniform by calendar year but we're starting with a resident who is alive on April 1. Let's first compute ${}_{0.25|0.5}q^{(2)}_x$, and then divide it by ${}_{0.25}p^{(\tau)}_x$.

The probability of dying in a time interval not crossing June 30 is the rate of death, 0.3, times the period of time, times the average, or midpoint, of survivors from the other two decrements, 1 and 3. For the period April 1–June 30, the midpoint of the period is May 15, or 3/8 of the way into the calendar year, and decrement 3 has not occurred yet, so

$${}_{0.25|0.25}q^{(2)}_x = 0.3(0.25)\left(1 - \tfrac{3}{8}(0.25)\right) = 0.0679688$$

For the period July 1–September 30, decrement 3 has occurred with survivorship rate 0.9, and the midpoint of the period is August 15, or 5/8 of the way into the calendar year, so

$${}_{0.5|0.25}q^{(2)}_x = 0.3(0.25)\left(1 - \tfrac{5}{8}(0.25)\right)(0.9) = 0.0569531$$

To compute ${}_{0.25}p^{(\tau)}_x$, we decrement (1) and (2) for 0.25 years:

$${}_{0.25}p^{(\tau)}_x = (1 - 0.25(0.3))(1 - 0.25(0.25)) = 0.8671875$$

The probability of dying between April 1 and September 30 is

$${}_{0.5}q^{(2)}_{x+0.25} = \frac{0.0679688 + 0.0569531}{0.8671875} = \boxed{\mathbf{0.14405}}$$

[10/6/2009] On page 691, in the solution to exercise 42.32, on the second line, $q'^{(1)}$ should be $q'^{(1)}_{20}$.

[10/6/2009] On page 698, on the third line of the answer to Example 44B, in the last integral, ${}_tp_x$ should be ${}_tp^{(\tau)}_{45}$.

[4/23/2009] On page 728, in the solution to exercise 45.10, on the first displayed line, add " + 14" after $\dfrac{1000A_{35}}{\ddot{a}_{35}}$.

[8/11/2009] On page 729, in the solution to exercise 45.13, on the 9th displayed line, replace $\dfrac{11.24}{0.897}$ with $\dfrac{11.24}{(11.925)(0.9897)}$.

[10/11/2008] On page 731, in the solution to exercise 45.23, on the fourth line, change $-I$ to $+I$.

[5/10/2009] On page 747, in the solution to Example 47C, on the second and fourth lines, change e_5 to e_4.

[10/6/2009] On page 761, on the second line from the end of the first paragraph, change ${}_kQ^{(i,i)}$ to ${}_kQ^{(i,j)}$.

[9/13/2008] On page 774, in the solution to exercise 48.16, on the fifth line, change "is 0.1, for a product of 0.05" to "is 0.2, for a product of 0.1".

[8/14/2009] On page 787, in the solution to exercise 49.9, change 0.04608 to 0.4608 on the line "No payment" and on the first white line of the table.

[8/16/2009] On page 801, 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 801, on the first line of the answer to Example 51A, change $t \geq 4$ to $T \geq 4$.

[4/26/2009] On page 802, in the sentence after the boldfaced sentence, and the word "know" between "not" and "how". Also, Quiz 51-1 is the same as Example 51D.

[8/16/2009] On page 806, in the solution to Quiz 51-2, on the first displayed line, change 0.0108 to $\dfrac{1}{0.0108}$.

[8/16/2009] On page 807, in the solution to Example 52A, change the final answer from 0.04656 to 0.04653.

[11/2/2008] On page 813, in exercise 52.20, on the first line after "guests arrive", add the words "in a Poisson process". Change the displayed line to

$$F(t) = t^2 \qquad 0 \le t \le 1$$

[4/27/2009] On page 815, in the solution to exercise 52.5, on the fifth line of the page, delete $\frac{1}{2}$ in front of $e^{-1/2}$.

[11/2/2008] On page 817, replace the solution to exercise 52.20 with

We must determine the mean value for guests arriving and not being greeted.

Guests arriving from times $t = 0$ to 1 are always greeted. For guests arriving at time $t > 1$, the probability of not being greeted by time 2, since there is $2 - t$ minutes from time t to time 2, is the complement of $F(2 - t)$, or $1 - (2 - t)^2$. We must integrate 2 guests per minute times this function from 1 to 2. To make the integral easier, we'll change the variable $u = t - 1$ and integrate 2 guests per minutes times $1 - (1 - u)^2$ from 0 to 1 to obtain the mean value:

$$\int_0^1 2\left[1 - (1-u)^2\right] \mathrm{d}u = 2 + \frac{2}{3}(1-u)^3\Big|_0^1 = \frac{4}{3}$$

The probability that at least 1 guest is ungreeted is $1 - e^{-4/3} = \boxed{\mathbf{0.736403}}$.

[8/16/2009] On page 817, in the solution to exercise 52.23, on the first displayed line, change 30 to 3.

[9/29/2009] On page 826, in the solution to exercise 53.4, on the fourth line, delete the word "twice".

[8/17/2009] On page 827, in the solution to exercise 53.12, on the third line, change 0.7λ to 0.7 (delete λ).

[4/27/2009] On page 827 in the solution to exercise 53.13, on the second line, change $2(1 + 1) = 2$ to $2(1 + 1) = 4$.

[10/12/2009] On page 833, in question 54.12, on the first line, change X_n to X_N.

[10/12/2009] On page 838, in the solution to question 54.8, on the displayed line, change $\mathbf{E}[X \mid I]$ to $\mathbf{E}[S \mid I]$.

[8/17/2009] On page 839, in the solution to exercise 54.10, on the last line, change 07422 to 0.7422.

[9/6/2009] On page 854, in question 5, on the last line of the question, delete "actuarial".

[4/29/2009] On page 859, in question 26(i), delete the words "variance of".

[4/26/2009] On page 914, in the solution to question 21, on the sixth line, replace 0.5 in the exponent with 5.

[11/3/2008] On page 933, in the solution to question 19, on the 3rd line from the end, replace 0.0061260 with 0.0056896.

[5/13/2009] On page 946, in the solution to question 26, the v's on lines 2–4 should be changed to $1 + i$:

$$0 = (1+i)\,{}_hV - {}_{h+1}V \qquad h = 7, 8, 9$$

Multiplying by $(1 + i)^{9-h}$ and adding up results in

$$0 = (1+i)^3\,{}_7V - {}_{10}V$$

[4/29/2009] On page 952, in the solution to question 13, on the first line, change L_x to l_x.

[9/7/2009] On page 959, in the solution to question 1, on the fifth line, delete the presubscript t from ${}_tp_{64}$.

[9/7/2009] On page 960, in the solution to question 4, on the first line, add "is" after $f(x)$.

[9/7/2009] On page 962, in the solution to question 10, on the second displayed line, the first exponent should be $-(0.01 + 0.03)t$; change the second minus to plus.

[5/13/2009] On page 972, in the solution to question 7, on the third and fourth displayed lines, the bounds on the second integral should be 0 to 1, not 1 and 2.

[9/7/2009] On page 974, in the solution to question 10, on the last line, put a bar on P.

[9/7/2009] On page 982, in the solution to question 6, on the second line from the end, there should be a double-dot on $s_{\overline{5|}}$.

[8/19/2009] On page 993, in the solution to question 1, in the table, interchange the column headings ${}_tp_x$ and q_{x+t}.

[8/19/2009] On page 994, the solutions to questions 13 and 14 are misnumbered 12 and 13 respectively.

[8/19/2009] On page 995, 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 996, 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.

[5/13/2009] On page 1010, in the solution to question 8, on the 7th line, change $v\,{}_{1/2}p_{30}$ to $v^{1/2}\,{}_{1/2}p_{30}$.

[5/13/2009] On page 1001, in the solution to question 21, on the fourth line, put parentheses around $\omega - 30$.

[8/18/2009] On page 1001, in the solution to question 23, on the first line, change ${}_kp_{xy}$ to ${}_kp_{\overline{xy}}$.

[4/29/2009] On page 1002, the solution to question 27 is incorrect after the second sentence. The correct solution, starting with the third sentence, is

Conveniently, $\mu_{50}^{(\tau)}(t) = 0.05$ for all t, so ${}_tp_{50}^{(\tau)} = e^{-0.05t}$.

$$\begin{aligned}
{}_{10}q_{50}^{(1)} &= \int_5^{10} {}_tp_{50}^{(\tau)}\,\mu_{50}^{(1)}(t)\mathrm{d}t \\
&= 0.02\int_5^{10} e^{-0.05t}\mathrm{d}t \\
&= 0.02\left(\frac{e^{-0.25}-e^{-0.5}}{0.05}\right) = \boxed{\mathbf{0.06891}} \qquad \textbf{(A)}
\end{aligned}$$

[8/18/2009] On page 1029, in the solution to question 2, on the 4th displayed line, there should be a dt before the equal sign.

[5/13/2009] On pages 1030–1031, in the solution to question 10, the second expression for $m(t)$ is incorrect. Replace all displayed lines with:

$$m(t) = \begin{cases} t/30 & t \le 45 \\ 45/30 + (t-45)/15 & t \ge 45 \end{cases}$$

$m(t)$ for $t > 45$ can be rearranged as follows:

$$m(t) = \frac{45}{30} + \frac{t-45}{15} = -\frac{3}{2} + \frac{t}{15}$$

Now we integrate the survival function.

$$\begin{aligned}\int_0^\infty s(x)\,\mathrm{d}x &= \int_0^{45} s(x)\,\mathrm{d}x + \int_{45}^\infty s(x)\,\mathrm{d}x \\ &= \int_0^{45} e^{-x/30}\,\mathrm{d}x + \int_{45}^\infty e^{3/2-t/15}\,\mathrm{d}x \\ &= 30\left(1-e^{-3/2}\right) + 15e^{3/2}e^{-3} \\ &= 30 - 15e^{-3/2} = \boxed{\mathbf{26.653}} \qquad \mathbf{(D)}\end{aligned}$$

[5/13/2009] On page 1035, in the solution to question 34, on the third displayed line, change $A_{51:\overline{9}|}$ to $A_{50:\overline{10}|}$.

[8/18/2009] On page 1035, in the solution to question 35, on the first displayed line, the 1000 should be outside the parentheses, so that the right hand side is

$$1000v\,(q_{80} + p_{80}\,A_{81})$$

[8/18/2009] On page 1036, in the solution to question 36, on the second line, change the denominator 796 to 776.

[8/20/2009] On page 1037, 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 1039, in the solution to question 27, the heading of the fifth column of the table should be ${}_tp_{65}^{(\tau)} = {}_{t-1}p_{65}^{(\tau)}(1-q_{65+t-1}^{(\tau)})$.

[8/19/2009] On page 1042, 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 1043, 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 1044, in footnote 1, delete one of the double vertical lines after 893.

[8/19/2009] On page 1045, in the solution to question 13, delete one of the double vertical lines in $\mathrm{Var}({}_1L \mid |K(x) \geq 1)$.

[11/3/2008] On page 1045, in the solution to question 13, the last line, starting after the colon, should read

death in year 2 ($\frac{1000}{1.1} - P$), death in year 3 ($\frac{1000}{1.1^2} - P - P/1.1$), and death after year 3 ($-P - P/1.1$).

[8/20/2009] On page 1053, in the solution to question 40, on the third line, "change" should be "chance".

[8/20/2009] On page 1054, in the solution to question 12, on the second line, change $2(10^7)$ to $2(10^{14})$ in two places.

[4/17/2009] On page 1056, in the solution to question 24, on the displayed line, $\ddot{a}_{35:\overline{1}|}$ should be $\ddot{a}_{39:\overline{1}|}$.

[8/9/2009] On page 1058, in Table C.1, the entry for Spring 2007:29 should be 17 instead of 32.