# Errata and updates for ASM Exam C/Exam 4 Manual (Eleventh Edition) sorted by page

Note: Practice exam 10:21 is defective. The question should be fixed as indicated below. Also note the corrections to practice exam 2:19 (page 1082), 3:2, and 7:33.

[8/12/2010] On page xv, there are errors in Table 1. Here is a corrected version:

| Topic | Lessons | May 2000 | Nov. 2000 | May 2001 | Nov. 2001 | Nov. 2002 | Nov. 2003 | Nov. 2004 | May 2005 | Nov. 2005 | Nov. 2006 | May 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Severity, Frequency, Aggregate Loss | 1–18 | 1 | 2 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 5 |
| Empirical Estimation | 19–26 | 4 | 2 | 2 | 4 | 4 | 5 | 4 | 6 | 5 | 9 | 7 |
| Parametric Fitting | 27–32 | 6 | 6 | 6 | 4 | 7 | 8 | 11 | 6 | 8 | 7 | 6 |
| Testing Fit | 33–37 | 2 | 0 | 3 | 2 | 2 | 2 | 3 | 4 | 4 | 1 | 3 |
| Limited Fluctuation Credibility | 38–40 | 1 | 1 | 0 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 |
| Bayesian Credibility | 41–46 | 4 | 5 | 5 | 4 | 3 | 5 | 3 | 3 | 3 | 5 | 3 |
| Bühlmann Credibility | 47–52 | 2 | 2 | 4 | 5 | 5 | 3 | 4 | 5 | 3 | 3 | 5 |
| Empirical Bayes | 53–54 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 | 2 |
| Simulation | 55–58 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 3 | 3 | 4 | 3 |
| Total | | 23 | 22 | 22 | 24 | 25 | 28 | 29 | 30 | 30 | 32 | 34 |

For the purpose of this table, F03:13 was classified as a probability-Lesson 1 question and F03:30 was classified as a parametric fit question, but neither question was based on the syllabus material then.

[11/7/2010] On page 9, in Theorem 2, change $\sum_i \Pr(B_i)=1$ to $\Pr(\cup_i B_i)=1$.

[6/8/2010] On page 13, in the fourth bullet of the second column of Table 1.1, replace $\Pr(X=x)$ with $\Pr(X=n)$.

[11/7/2010] On page 13, in Law of Total Probability second line, change $\sum_i \Pr(B_i)=1$ to $\Pr(\cup_i B_i)=1$.

[9/27/2011] On page 20, in the solution to exercise 1.7, on the first displayed line, change $\mathbf{E}[X+Y]^3$ to $\mathbf{E}[(X+Y)^3]$.

[9/27/2011] On page 28, on the second line of Example 2E, replace $x$ with $X$.

[6/2/2010] On page 29, on the 4th displayed line from the end of the page, replace $F_X(1/y)$ with $S_X(1/y)$ and $1-e^{-1/(y\theta)}$ with $e^{-1/(y\theta)}$. On the 2nd to last line of the page, delete $1-$.

[8/5/2011] On page 32, replace the second sentence of Subsection 2.3.4 with

If $Y$ is exponential with mean $\mu$, then $X=Y^{1/\tau}$ is Weibull with parameters $\theta=\mu^{1/\tau}$ and $\tau$.

[5/29/2010] On page 33, in the second sentence of Subsection 2.3.6, change the single-quote after "parameter" to a double-quote.

[6/2/2010] On page 34, in the first displayed line of Subsection 2.3.7, replace the exponent $\alpha-1$ with $\alpha+1$.

[5/21/2010] On page 36, in Table 2.1, for the Single-parameter Pareto, replace the denominator $\theta^{\alpha+1}$ with $x^{\alpha+1}$.

[9/27/2011] On page 37, on the seventh line of the paragraph beginning "**Normal distribution**", replace $r(x)$ with $r(\theta)$.

[11/10/2010] On page 51, in the first two displayed equations, the $x_i$ in parenthesis should be $x$.

[10/28/2010] On page 62, in exercise 4.6, on the last line, add the word "of" after "coefficient".

[7/5/2010] On page 68, in the solution to exercise 4.8, add $d\lambda$ after $e^{-\lambda}$ on the two displayed lines.

[12/3/2010] On page 69, in the solution to exercise 4.11, on the 2nd line of the page, change the exponent $\alpha$ to $-\alpha$.

[6/6/2010] On page 80, in exercise 5.12, on the second line, delete the word "expected".

[10/28/2010] On page 81, in the solution to exercise 5.6, change $X \wedge 1000$ to $X \wedge 5000$.

[8/22/2010] On page 82, in the solution to exercise 5.9, on the first displayed line, add a standard-sized right parenthesis after 4000.

[2/8/2011] On page 85, on the first line of the third paragraph, change "then" to "than".

[5/5/2010] On page 86, in the solution to Example 6B, replace the third line with

To this, we add $500S(500) = 500(0.3) = 150$ for a total expected payment per loss of $\boxed{\mathbf{400}}$.

Replace the last line with

Once again we would add $500S(500)$ to this to get the final answer of 400.

[5/29/2010] On page 116, in exercise 7.19, replace 1999 with 2009 in three places—4 lines from the end, 3 lines from the end (subscript), and 1 line from the end.

[11/13/2010] On page 118, in the solution to exercise 7.4, the left hand side of the displayed line is incorrect. Replace the displayed line with

$$\begin{aligned}\mathbf{E}[X \wedge d] &= \mathbf{E}[X \wedge d \mid X < d]\Pr(X < d) + \mathbf{E}[X \wedge d \mid X \geq d]\Pr(X \geq d)\\ &= (\text{Average loss} < d)\Pr(X < d) + d\Pr(X \geq d)\\ &= 500(0.6) + d(0.4)\end{aligned}$$

[10/5/2011] On page 121, in the solution to exercise 7.13, on the third line, change the period after the first "doubled" to a comma.

[5/29/2010] On pages 122–123, replace the subscript 1998 with 2008 (4 lines from bottom of page 122) and the subscript 1999 with 2009 (5th line of page 123).

[6/30/2010] On page 128, 6 lines from the bottom, the first word "loss" should be "let".

[5/1/2011] On page 134, second line from bottom of page, some parentheses are missing. The line should read

$$= \mathbf{E}[X]\left(\frac{1-\Phi\left(\frac{\ln\left(\exp(\mu+z_p\sigma)\right)-\mu-\sigma^2}{\sigma}\right)}{1-p}\right)$$

[5/17/2010] On page 136, on the 6th line of Section 8.4, delete the first "are".

[5/26/2010] On page 149, first displayed line, change the first $-$ to $=$.

[9/6/2010] On page 151, on the fifth displayed line, replace $2d$ with $2d^*$.

[6/28/2010] On page 156, in exercise 9.19(D), change $5000 < X_i \leq 631{,}250$ to $6250 < X_i \leq 631{,}250$.

[5/16/2011] On page 165, in the solution to exercise 9.18, 3 lines from the end, delete "given that it".

[5/22/2010] On page 180, on the second line of Section 11.2, delete the right parenthesis after 2007. The sentence containing this error is ambiguous; here's a rewritten sentence:

When they moved severity, frequency, and aggregate loss material to Exam C/4 in 2007, they added material on the $(a,b,1)$ class back to the syllabus.

[5/18/2010] On page 180, the line above Example 11B should be

$$p_n^M = (1 - p_0^M) p_n^T \qquad n > 0$$

[6/28/2010] On page 205, add a period on the first line after the word "syllabus".

[6/30/2010] On page 207, at the end of the fifth line, replace $p_0^M$ with $p_0^{M*}$.

[6/28/2010] On page 226, in the solution to exercise 14.1, on the last line, change $\left(\frac{1}{2}\right)^2$ to $\left(\frac{1}{2}\right)^4$.

[6/28/2010] On page 255, the solution to exercise 15.27 is incorrect. The correct solution is

We calculate aggregate mean and variance.

$$\begin{aligned}
\mathbf{E}[S] &= 0.7e^{5+0.5(1.2^2)} = 213.4334 \\
\text{Var}(S) &= 0.7e^{10+2(1.2^2)} = 274{,}669.8 \\
\mathbf{E}[S^2] &= 274{,}669.8 + 213.4334^2 = 320{,}223.7
\end{aligned}$$

We solve for the $\mu$ and $\sigma$ parameters of the lognormal having this mean and second moment.

$$\begin{aligned}
\mu + 0.5\sigma^2 &= \ln 213.4334 \\
2\mu + 2\sigma^2 &= \ln 320{,}223.7 \\
\sigma^2 &= \ln 320{,}223.7 - 2\ln 213.4334 = 1.9501 \\
\sigma &= 1.3965 \\
\mu &= \ln 213.4334 - 0.5(1.3965) = 4.3883
\end{aligned}$$

Now apply the lognormal approximation.

$$\Pr(S > 300) = 1 - \Phi\left(\frac{\ln 300 - 4.3883}{1.3965}\right) = 1 - \Phi(0.94) = \boxed{\mathbf{0.1736}}$$

[6/30/2010] On page 256, on the second to last line of the solution to exercise 15.29, replace "the 90th percentile of aggregate losses" with "TVaR at the 90% security level".

[11/8/2010] On page 284, in the solution to exercise 17.24, at the end of the first line, add (after "than") "or equal to".

[2/15/2011] On page 290, on the last line, change $m_0^1$ to $m_1^0$.

[6/12/2010] On page 301, in the solution to exercise 18.15, one line above "**Second method**", change $\mathbf{E}\left[(Y^P)^2\right]^2$ to $\mathbf{E}[Y^P]^2$.

[7/2/2010] On page 314. on the first line of Table 19.1, the formula for bias should be $\text{bias}_{\hat{\theta}}(\theta) = \mathbf{E}[\hat{\theta} \mid \theta] - \theta$.

[5/29/2010] On page 314, on the last line of Table 19.1, there should be expected value around $(\hat{\theta} - \theta)^2$ and $\text{bias}_{\hat{\theta}}(\theta)$ should be squared, so the formula should read

$$\text{MSE}_{\hat{\theta}}(\theta) = \mathbf{E}[(\hat{\theta} - \theta)^2 \mid \theta] = \text{bias}_{\hat{\theta}}^2(\theta) + \text{Var}(\hat{\theta})$$

[4/24/2011] On page 315, in equation (19.3), remove the hat on $v(\theta)$.

[6/30/2010] On page 323, on the first line of the solution to exercise 19.7, add "unbiased" between "variance" and "estimator", and also between "an" and "estimator".

[7/2/2010] On page 326, in the solution to exercise 19.22, replace the fifth line from the end (beginning $\text{bias}_{\hat{\theta}}(\theta)$) with

$$\left(\text{bias}_{\hat{\theta}}(\theta)\right)^2 = \text{Var}(\hat{\theta})$$

[8/20/2010] On page 330, one line below equation (20.1), change $(c_{j=1}, c_j)$ to $[c_{j-1}, c_j)$. The textbook arbitrarily makes the histogram right continuous.

[9/27/2011] On page 336, 3 lines above equation (21.3), delete one of the periods after "constant".

[10/6/2011] On page 344, in the solution to exercise 21.11, on the second line, replace "$m = \theta$ and $q = n = 50$" with "$m = n = 50$ and $q = \theta$".

[11/11/2010] On page 347, on the last line of the last bullet, change "amount" to "time".

[11/27/2010] On page 350, in the first table, in the heading, replace $y_j \le t \le y_{j+1}$ with $y_j \le t < y_{j+1}$.

[3/4/2011] On page 363, in the solution to exercise'22.8, on the first displayed line, change $n - t + 1$ to $n - i + 1$.

[7/22/2011] On page 372, 2 lines from the bottom of the second paragraph, remove the right parenthesis after 0.6. On the last line of the paragraph, add "'is" between (8000, 10,000) and (0.1)(0.4).

[9/27/2011] On page 373, one line below the first two displayed lines, remove the right parenthesis after Nelson-Åalen.

[6/30/2010] On page 376, at the end of the first line of Quiz 23-2, delete the word "are".

[7/24/2011] On page 379, in exercise 23.4, on the line after the table, add a period after "interval".

[8/10/2010] On page 387, in formula (24.1), delete the upper bound $j$ on the sum.

[11/26/2010] On page 389, in the answer to Example 24C, 3 line from the end, change 0.004618 to 0.0004618.

[8/10/2010] On page 390, in formula (24.1), delete the upper bound $j$ on the sum.

[7/9/2010] On page 401, in the solution to exercise 24.25, on the second to last line, change both 0.8's to $\ln 0.8$.

[6/30/2010] On page 407, in the fifth bullet, change $F(11) = 0.375$ to $F(11) = 0.25$.

[2/27/2011] On page 411, five lines below Figure 25.5, change $\hat{f}(11.6)$ to $\hat{k}(11.6)$.

[6/8/2010] On page 426, the answer to exercise 25.1 should be 0.0625 instead of 0.00625.

[9/14/2010] On page 430, in the solution to exercise 25.19, on the fourth and fifth lines, change $X$ and $X^2$ to $Y$ and $Y^2$.

[4/12/2011] On page 433, in the third paragraph's first line, change "starting at $c_{j-1}$ and ending at $c_j$]] to "'starting at $c_j$ and ending at $c_{j+1}$".

[12/1/2010] On page 434, on the first line, change "an including" to "and including".

[4/12/2011] On page 436, at the end of the first line of the answer to Example 26C, change $P_{j-1}$ to $P_j$.

[7/24/2011] On page 439, one line above the exercises, change $(100 - 75)$ to $(100 - 25)$.

[4/12/2011] On page 444, in the solution to exercise 26.6, in the table's header, change $c_{j-1}$ to $c_j$ and $P_{j-1}$ to $P_j$.

[2/11/2011] On page 475, on the first displayed line of the page, change $y_{(n+1)p}$ to $x_{(n+1)p}$.

[6/2/2010] On page 476, three lines above Example 28B, change $-\theta(1-p)$ to $-\theta\ln(1-p)$.

[9/16/2010] On page 476, two lines above Example 28B, change $\text{Var}_p$ to $\text{VaR}_p$.

[9/16/2010] On page 477, two lines above Example 28C, change $\text{Var}_p$ to $\text{VaR}_p$.

[8/5/2010] On page 493, in the solution to Quiz 28-1, change the equation at the end to $0.2(20) + 0.8(70) = \boxed{\mathbf{60}}$.

[10/15/2010] On page 478, on the second to last line of Example 28E, change $\alpha$ to $\tau$.

[8/15/2010] On page 516, in the solution to Quiz 29-1, on the first displayed line, add $\theta^5$ to the right-hand side: $\theta^5 \exp(-0.051304\theta)$.

[4/11/2011] On page 518, on the seventh line of the page, change "Let'e" to "Let's".

[5/25/2011] On page 524, on the first line of Example 30H, change 300 to 261.

[7/28/2010] On page 524, in the heading of the table for Example 30H, interchange "Policyholders" and "Claims".

[7/28/2010] On page 526, the last four lines of the answer to Example 30H are incorrect. Replace them with:

$$= (1-p)^{258} p^{113}$$

and therefore $\hat{p} = 113/(113+258) = 0.30458$. Then

$$\frac{\beta}{1+\beta} = 0.30458$$
$$\hat{\beta} = \frac{0.30458}{0.69542} = \boxed{\mathbf{0.4380}}$$

[11/19/2010] On page 534, in exercise 30.19(iii), add "follow a" after "to".

[1/12/2011] On page 546, in the solution to exercise 30.23, on the fifth line, remove the negative sign in front of $\frac{2}{\theta^3}$.

[8/17/2010] On page 551, in the solution to exercise 30.37, on the fourth displayed line, add "$x_i$" after the product sign before the equals sign.

[10/16/2010] On page 556, in the solution to Quiz 30-2, on the last line, add a negative sign to the denominator: $-3.02990$.

[9/21/2010] On page 561, on the 5th line of the **Weibull distribution** paragraph, remove one $d$ from the numerator of the left-hand side.

[12/5/2010] On page 561, 3 and 4 lines from the bottom, change $L(\theta)$ and $l(\theta)$ to $L(\alpha)$ and $l(\alpha)$. On page 562 on the first displayed line, change $L(\alpha)$ to $L(\theta)$.

[3/17/2011] On page 562, on the third displayed line of the paragraph "Lognormal distribution", remove the minus sign before $\frac{\sum(\ln x_i - \mu)}{\sigma^2}$.

[8/8/2010] On page 567, one line under formula (31.5), put a prime on $\left(\frac{\partial g}{\partial x_1}, \ldots, \frac{\partial g}{\partial x_k}\right)$.

[8/9/2010] On page 570, once apiece on each of the three displayed lines of the answer to Example 31K, change $x$ to $\theta$.

[7/27/2011] On page 627, on the heading row, fifth column of the table, $F(c_j)$ should be $F^*(c_j)$.

[6/28/2010] On page 636, in the solution to exercise 34.6, on the first line of the table, in columns 3 and 4, $F^-(x_j)$ should be $F_5^-(x_j)$ and $F(x_j)$ should be $F_5(x_j)$.

[7/28/2011] On page 644, 4 lines from the end of the solution to exercise 35.1, remove the inner square on $F_n(1)$: make it $\left(F_n(1)\right)^2$.

[7/28/2011] On page 644, on the first displayed line of the solution to exercise 35.2, remove the inner square from $F_n(0.05)$; make it $\left(F_n(0.5)\right)^2$.

[8/18/2010] On page 644, in the solution to exercise 35.4, on the last line of the table, change 50 to 60.

[2/15/2011] On page 646, in the solution to exercise 35.8, on the last line, change 0.9048 to 0.9046 and change the final answer to 4.1976.

[8/12/2010] On page 647, replace the sentence after equation (36.1) with:

You know that to calculate (biased) sample variance, you can use the definition, $\sum(x_i-\bar{x})^2/n$, or you can use an alternative formula, $\sum x_i^2/n-\bar{x}^2$.

[8/11/2010] On page 670, in exercises 36.30 and 36.32, on the first lines of both, change 1995–1998 to 2005–2008.

[10/19/2010] On page 678, in the solution to Quiz 36-1, on the third line, change $1-e^{-0.25}$ to $1-e^{-4}$.

[7/13/2010] On page 680, on the fifth line, replace "two=parameter" with "2-parameter". On the top line of the table for Quiz 37-1, replace "Negative" with "Maximal".

[12/11/2010] On page 697, one line after the numbered list, delete the words "of number".

[11/23/2010] On page 710, in the solution to exercise 38.13, on the first line, $n_0$ should be $n_F$.

[7/13/2010] On page 716, on the first displayed line and denominator of the third displayed line, replace $\sigma_f$ with $\mu_s$; on the second displayed line and numerator of the third displayed line, replace $\sigma_s$ with $\sigma_s^2$ and $\sigma_f$ with $\sigma_f^2$. The three displayed lines will then be

$$\begin{aligned}\mathbf{E}[S] &= \mu_f\mu_s\\ \text{Var}(S) &= \mu_f\sigma_s^2+\sigma_f^2\mu_s^2\\ n_F &= \mu_f n_0\frac{\mu_f\sigma_s^2+\sigma_f^2\mu_s^2}{\mu_f^2\mu_s^2}\end{aligned}$$

[7/13/2010] On page 716, in Example 39A, on the fifth line, replace 10% with 5%.

[7/29/2011] On page 716, on the displayed line in the answer to Example 39A, replace $n_0$ with $n_F$.

[8/22/2010] On page 739, change the first paragraph of Quiz 41-1 to:

For a certain insurance coverage, only one claim per year can be submitted. There are two types of group. In a good group, the expected annual number of claims from each risk is 0.1. In a bad group, the expected annual number of claims from each risk is 0.2. The probability that a group is good is 70%.

[2/12/2011] On page 763, in the solution to exercise 41.25, change the final answer 0.7312 to 0.7311 in two places, and change 0.2688 on the last line of the table to 0.2689.

[6/28/2010] On page 769, on the table's fourth line, change 0.022619 to 0.22619.

[11/29/2010] On page 771, in equation (42.2), replace (in the integrand) $f(x_1,\ldots,x_n\,|\,\theta)$ with $f(x_{n+1}\,|\,\theta)$.

[6/8/2010] On page 772, 3 lines from the end of the answer to Example 42A, the numerator of the fraction should be $e^{-3\lambda}$; delete $\lambda$.

[7/20/2010] On page 774, on the first displayed line, change the lower bound of the integral from 5 to 3.

[2/14/2011] On page 774, on the last line of the page, change 0.0064 to 1/0.2176.

[2/14/2011] On page 778, on the second line of the answer to Example 42F, the final exponent is missing a $\theta$: $e^{-0.305\theta}$.

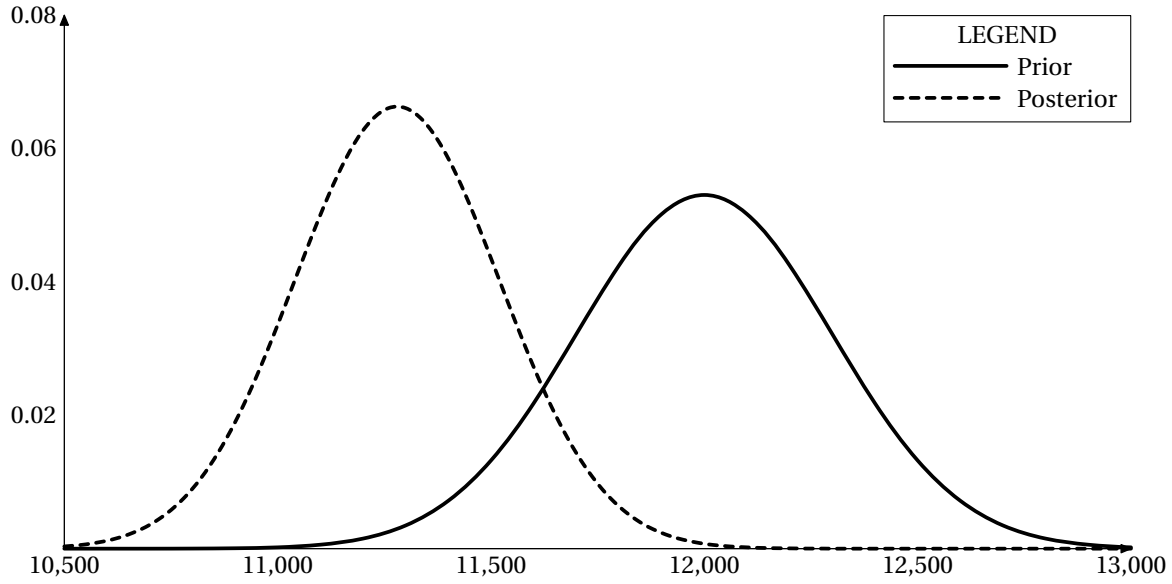
[7/20/2010] On page 786, in the solution to exercise 42.2, in the paragraph starting "As an alternative" on the second line, replace $3\lambda 3^{-3\lambda}$ with $3\lambda e^{-3\lambda}$.

[2/14/2011] On page 787, in the solution to exercise 42.3, on the third line, add a 4 to the first exponent in the numerator: $-\lambda e^{-4\lambda}$.

[10/23/2010] On page 790, in the solution to exercise 42.9, on the second displayed line of the page, the middle and right-hand side should be $\frac{2\pi}{\pi}-2\left(\frac{2}{\pi}\right)=2-\frac{4}{\pi}$. On the third displayed line, the denominator should be $2-4/\pi$.

[2/16/2011] On page 793, in the solution to exercise 42.17, on the last line, change $0.5^10$ to $0.5^{10}$.

[12/16/2010] On page 815, Figure 44.1 should be replaced with this:




[2/19/2011] On page 819, on the last line of the solution to exercise 44.8, $1797.03-1500$ should be $1500-1797.03$.

[12/18/2010] On page 824, on the fourth line of Example 45C, replace all three $x$'s with $p$'s so that it reads

$$\pi(p)=6p(1-p) \quad 0\le p\le 1$$

[2/26/2011] On page 826, in the solution to exercise 45.12, on the second line, change $a+*$ to $a_*$.

[9/2/2010] On page 829, the solution to exercise 45.12 is incorrect. The correct solution is

The model is negative binomial with $r=2$. The prior distribution is beta with $a=1$, $b=1$. The posterior is $a+*=a+nr=1+1(2)=3$, $b_*=b+n\bar{x}=1+1(0)=1$. The predictive mean is $rb/(a-1)=2(1)/(3-1)=\boxed{\mathbf{1}}$. Notice that the original mean is infinite.

[5/1/2010] On page 853, in the solution to question 47.12, replace $\lambda$ (once on the second line and twice apiece on the first four displayed lines) with $\theta$.

[9/4/2010] On page 869, question 48.24 is defective. Replace it with the following.

An insurance portfolio has two classes of risk, A and B. You are given:

(i) For class A, the number of claims per year for each insured has a binomial distribution with parameters $m=2$, $q=0.25$. The size of each claim is 1000.
(ii) For class B, the number of claims per year for each insured has a binomial distribution with parameters $m=4$, $q=0.25$. The size of each claim is 1000.
(iii) Each class is equally large.
(iv) Claim counts and sizes are independent.

An insured is selected at random. After 5 years of experience, the Bühlmann credibility estimate for aggregate losses for that insured is 700.

Determine the average aggregate losses per year for that risk.

(A) Less than 575
(B) At least 575, but less than 625
(C) At least 625, but less than 675
(D) At least 675, but less than 725
(E) At least 725

[8/31/2010] On page 878, on the line before "Solutions", delete "C-S07:36" and the preceding comma. This question is a Bühlmann- Straub question

[9/4/2010] On pages 885–886, replace the solution to question 48.24 (note that the question is changed, see errata for page 869) with the following.

The hypothetical means of the two classes are

$$\mu_A = 1000mq = (1000)(2)(0.25) = 500$$
$$\mu_B = 1000mq = (1000)(4)(0.25) = 1000$$

Therefore, the overall mean and the variance of hypothetical means are (the latter by the Bernoulli shortcut):

$$\mu = 0.5(1000) + 0.5(500) = 750$$
$$a = \tfrac{1}{4}(500^2) = 62{,}500$$

The process variances of the two classes are

$$v_A = 10^6 \operatorname{Var}(N) = 10^6 mq(1-q) = 10^6(2)(0.25)(0.75) = 375{,}000$$
$$v_2 = 10^6 \operatorname{Var}(N) = 10^6 mq(1-q) = 10^6(4)(0.25)(0.75) = 750{,}000$$

The expected value of the process variance is

$$v = 0.5(375{,}000 + 750{,}000) = 562{,}500$$

The credibility factor is

$$Z = \frac{na}{na+v} = \frac{62{,}500(5)}{62{,}500(5)+562{,}500} = \frac{5}{14}$$

Therefore, backing out the average aggregate losses $\bar{x}$:

$$750\left(\frac{9}{14}\right) + \bar{x}\left(\frac{5}{14}\right) = 700$$
$$\bar{x} = \frac{700 - 750(9/14)}{5/14} = \boxed{\mathbf{610}} \qquad \textbf{(B)}$$

[8/31/2010] On page 930, on the line before "Solutions", add ",36" at the end of the line.

[7/20/2010] On page 931, in the solution to exercise 50.3, on the second displayed line, replace $lambda$ with $\lambda$.

[7/20/2010] On page 937, on the third line of the second paragraph, delete the first appearance of the word "a".

[7/20/2010] On page 943, in the solution to exercise 51.11, on the first line, $Z = 9/(9+3a)$, not $9/(9+2a)$. Also, the tables do not list the mode of a beta. The proof that the mode of the distribution is $(a-1)/(a+b-2)$ for the given $f$ is:

$$\begin{aligned}
\ln f(\theta) &= \ln\Gamma(a+b) - \ln\Gamma(a) - \ln\Gamma(b) + (a-1)\ln\theta + (b-1)\ln(1-\theta) \\
\frac{\mathrm{d}\ln f(\theta)}{\mathrm{d}\theta} &= \frac{a-1}{\theta} - \frac{b-1}{1-\theta} = 0 \\
(a-1)(1-\theta) - (b-1)\theta &= 0 \\
\theta(a+b-2) &= a-1 \\
\theta &= \frac{a-1}{a+b-2}
\end{aligned}$$

[8/31/2010] On page 945, on the line below the first displayed line (equation for $\bar{Y}_i$), change "in such as way" to "in such a way".

[7/25/2010] On page 945, 5 lines from the bottom, replace $b$ with $\beta$.

[1/19/2011] On page 946, in the first line of the answer to Example 52A, change "tht" to "that".

[7/25/2010] On pages 953–954, change $\mathbf{E}[X^2]$ to $\mathrm{Var}(X)$ in the following places:

- Third and fourth displayed lines of solution to exercise 52.1.
- First and third lines of solution to exercise 52.4.
- Second and fourth lines of solution to exercise 52.5.

[7/25/2010] On page 962, on the first line, change "Group A" to "Policyholder 1".

[10/10/2010] On page 962, 3 lines from the bottom of the page, change $\left(\frac{1}{0.05}\right)$ to $(0.05)$.

[10/26/2010] On page 969, in exercise 53.15, two lines under the table, change $m_j$ to $m_i$.

[3/21/2011] On page'977, in the solution to exercise 53.11, two lines from the end, change 0.983272 to 0.938272.

[6/14/2010] On page 981, the last three lines of the solution to Quiz 53-1 are incorrect, and should be

$$\begin{aligned}
\hat{a} &= (0.25-0.75)^2 + (1.25-0.75)^2 - \frac{7/12}{4} = 0.354167 \\
\hat{Z} &= \frac{4\hat{a}}{4\hat{a}+\hat{v}} = \frac{1.41667}{1.41667+7/12} = 0.708333 \\
P_C &= 0.708333(0.25) + (1-0.708333)(0.75) = \boxed{\mathbf{0.395833}}
\end{aligned}$$

[7/8/2010] On page 983, starting with the last displayed formula and through the ensuing paragraph, all $n$'s (there are six of them) should be changed to $r$'s, where $r$ is the number of policyholders (consistent with the meaning of $r$ in the previous lesson).

[7/25/2010] On page 985, on the second to last line, after (53.3), change the comma to a period. On the last line, change 280 to 250.

[7/25/2010] On page 987, on the second line of the answer to Example 54D, change "twice the mean" to "1.4 times the mean".

[3/23/2011] On page 1000, in the solution to exercise 54.12, replace the last displayed line with

$$\hat{a} = (3-2)^2 + (1-2)^2 - \frac{2}{3} = \frac{4}{3}$$

[9/16/2010] On page 1005, on the last line, change $\text{Var}_p$ to $\text{VaR}_p$.

[10/31/2010] On page 1008, on the line between the two tables, delete "would" after "rule".

[8/6/2011] On page 1010, in exercise 55.5, on the last line of the table, replace $n$ with $m$.

[1/19/2011] On page 1020, in the solution to exercise 55.8, on the first line, change "and 4" to "and 1".

[8/11/2010] On page 1027, on the second line under the heading "**Mean**", change $s^2$ to $s_n^2$.

[7/25/2010] On page 1028, on the fifth line of the subsubsection headed "Probabilities", add the word "the" before "estimator".

[1/12/2011] On page 1028, 7 lines from the bottom, change $100p$th to $100\pi$th.

[8/12/2010] On page 1029, 6lines above Example 54C, replace $\lfloor np \rfloor$ with $\lfloor nq \rfloor$.

[8/12/2010] On page 1030, replace the fifth bullet in Table 56.1 with "$s_n$ is the square root of the unbiased sample variance after $n$ runs."

[6/10/2011] On page 1031, in exercise 56.1, the last column of the table is obviously inconsistent with the previous column, and the $S_i^2$ column is inconsistent with the previous column. This question was adapted from the sample exam, but the $t$ column had to be changed due to a change in the Ross textbook when it was on the syllabus, and the result was an inconsistent table. To fix the question, replace the table and the paragraph preceding the table with:

You want to be 95% certain that your estimate will not differ from the true value by more than 0.01 units. Your estimates of profitability, $X_i$, for the first 120 policies reviewed, together with the indicated statistics, are shown below.

| $i$ | $X_i$ | $\bar{X}_i$ | $S_i^2$ | $S_i$ | $S_i/\sqrt{i}$ |
|---|---|---|---|---|---|
| 1 | 1.0795 | 1.0795 | | | |
| 2 | 1.0559 | 1.0677 | 0.00027908 | 0.0167 | 0.011813 |
| 3 | 1.1062 | 1.0806 | 0.00063266 | 0.0252 | 0.014522 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |
| 100 | 1.0066 | 1.0787 | 0.00269721 | 0.0519 | 0.005193 |
| 101 | 1.1691 | 1.0796 | 0.00275115 | 0.0525 | 0.005219 |
| 102 | 1.0834 | 1.0796 | 0.00272405 | 0.0522 | 0.005168 |
| 103 | 1.1272 | 1.0801 | 0.00271931 | 0.0521 | 0.005138 |
| 104 | 1.0722 | 1.0800 | 0.00269351 | 0.0519 | 0.005089 |
| 105 | 1.1373 | 1.0806 | 0.00269886 | 0.0520 | 0.005070 |
| 106 | 1.0428 | 1.0802 | 0.00268661 | 0.0518 | 0.005034 |
| 107 | 1.0759 | 1.0802 | 0.00266144 | 0.0516 | 0.004987 |
| 108 | 1.1418 | 1.0807 | 0.00267174 | 0.0517 | 0.004974 |
| 109 | 1.1249 | 1.0811 | 0.00266489 | 0.0516 | 0.004945 |
| 110 | 1.2350 | 1.0825 | 0.00285565 | 0.0534 | 0.005095 |
| 111 | 1.0478 | 1.0822 | 0.00284056 | 0.0533 | 0.005059 |
| 112 | 1.0875 | 1.0823 | 0.00281522 | 0.0531 | 0.005014 |
| 113 | 1.1149 | 1.0826 | 0.00279950 | 0.0529 | 0.004977 |
| 114 | 1.1591 | 1.0832 | 0.00282611 | 0.0532 | 0.004979 |
| 115 | 1.0226 | 1.0827 | 0.00283329 | 0.0532 | 0.004964 |
| 116 | 0.9668 | 1.0817 | 0.00292447 | 0.0541 | 0.005021 |
| 117 | 1.1487 | 1.0823 | 0.00293761 | 0.0542 | 0.005011 |
| 118 | 1.1887 | 1.0832 | 0.00300848 | 0.0548 | 0.005049 |
| 119 | 1.1303 | 1.0836 | 0.00300164 | 0.0548 | 0.005022 |
| 120 | 1.0484 | 1.0833 | 0.00298673 | 0.0547 | 0.004989 |

[6/10/2011] On page 1033, consistent with the change to the exercise, change the solution to exercise 56.1 to

Your objective is met when the 1.96 times the standard deviation (estimated by the last column, $S_i/\sqrt{i}$) is less than or equal to 0.01, or

$$\frac{S_i}{\sqrt{i}} \le \frac{0.01}{1.96} = 0.005102$$

(Technically speaking we need a $t$ coefficient rather than 1.96, but the difference is small for large $i$.) $i =$ **104** is the first time that this happens.

On page 1040, on the sixth line, add the following sentence before "However":

Since $\text{TVaR}_q(X)$ is the *mean* of the upper tail of the distribution, we might think that all we need to do is divide $s_q^2$ by $n$, the same way we estimate the variance of the sample mean.

On the seventh line, replace $s_q^2$ with $s_q^2/n$.

[7/25/2010] On page 1058, on the last line of the answer to Example 58B, insert a small left parenthesis before 11.56 and a large right parenthesis after $(158.76-341.04)^2$.

[7/25/2010] On page 1064, in the solution to exercise 58.9, on the second displayed line, the expression inside the brackets on the left should be squared:

$$\mathbf{E}_{F_e}\left[\left(\frac{1}{2}\Big((x_2-\bar{x})+(x_3-\bar{x})\Big)\right)^2\right]$$

[8/9/2010] On page 1066, on the last line, the final answer should be 49/27 instead of 56/27.

[11/26/2010] On page 1072, in question 14, on the fourth line, delete the first "numbers".

[6/16/2011] On page 1082, in question 19, on the second line, change "varies by exposure" to "varies by group".

[5/10/2011] On page 1083, in question 20, on the second line, change "psuedorandom" to "pseudorandom".

[11/27/2010] On page 1086, in question 34:

1. On the second line, delete the words "per claim".
2. Change the last line to "Calculate the square root of the simulated unbiased sample variance of the annual reimbursement".

[8/12/2010] On page 1089, in question 2, interchange "'policies" and "claims" in the head of the table.

[5/10/2011] On page 1098, in question 6, on the second line, change "psuedorandom" to "pseudorandom".

[11/28/2010] On page 1104, on the second line of question 30, change "not less be" to "not be less".

[11/29/2010] On page 1109, in question 15, change the last four lines to:

Two different assumptions are used to estimate S(60):

(i) $\hat{S}(60)$ is the estimate if all new entries and withdrawals occur at interval boundaries.
(ii) $\tilde{S}(60)$ is the estimate if all new entries and withdrawals occur uniformly throughout the interval.

[11/30/2010] On page 1132, in question 33, on the line below the table, change "average payment per loss" to "average payment per payment".

[12/1/2010] On page 1137, in question 9, add the word "Annual" before the first sentence: "Annual claim counts…", and delete "Annual" from the second sentence.

[5/10/2011] On page 1148, in question 12, on the first line, change "psuedorandom" to "pseudorandom".

[5/10/2011] On page 1158, in question 11, on the second line, change "psuedorandom" to "pseudorandom".

[5/3/2010] On page 1160, in question 21(ii), add 0.75 to $P(z)$:

$$P_X(z) = 0.75 + \frac{\left(1-3(z-1)\right)^{-1} - 0.25}{3}$$

Change the answer choices to

(A) 1/27 (B) 2/27 (C) 4/27 (D) 8/27 (E) 16/27

[8/9/2010] On page 1171, in the solution to question 11, on the fourth line of the page, change $(1-x)^2$ to $(1-x^2)$.

[5/2/2010] On page 1180, in the solution to question 6, 2 lines from the bottom of the page, change $50^8$ to $50^{8\alpha}$.

[8/11/2010] On page 1181, in the solution to question 7, 2 lines from the end, change 1.775123 in the denominator to 1.775173.

[8/11/2010] On page 1181, in the solution to question 9, 3 lines from the bottom of the page, change the comma after "point" to a period.

[8/11/2010] On page 1183, in the solution to question 15, on the last line, change $p_0^M = 0.2$ to $p_0^M = 0.25$.

[8/11/2010] On page 1185, in the solution to question 20, on the second and fourth displayed lines, change 101.25 to 100.25. On the second to last line, add the word "is" before $531-517$.

[8/12/2010] On page 1187, in the solution to question 29, on the last line of the page, add $x$ after 2(0.035625).

[1/15/2011] On page 1188, in the solution to question 32, on the fourth displayed line, change $F_{Y_1}(y_1)$ to $S_{Y_1}(y_1)$. Two lines lower, change $\mathbf{E}[Y_1+Y_2]$ to $\mathbf{E}[Y_2]$.

[11/27/2010] On page 1189, in the solution to question 34, change "The unbiased standard deviation" to "The square root of the unbiased sample variance".

[8/12/2010] On page 1194, in the solution to question 16, on the last displayed line, change 0.5478 to 0.5517 and 0.4522 to 0.4483.

[8/12/2010] On page 1201, add "[**Lesson 49**]" after "34." at the beginning of the solution to question 34.

[4/26/2010] On page 1216, in the solution to question 3, on the second line, change $(1+e^{-x})$ to $(x+e^{-x})$.

[3/4/2011] On page 1218, in the solution to question 13, on the last line, replace $\frac{(}{8}/9)\theta$ with $(8/9)\theta$. Also, change the two $M$'s to $\hat{\theta}$'s.

[11/29/2010] On page 1219, in the solution to question 15, 2 lines from the end, change $\hat{S}(60)$ to $\tilde{S}(60)$.

[2/22/2011] On page 1222, in the solution to question 28, change $1-q'^{10}$ to $(1-q')^{10}$.

[11/29/2010] On page 1225, in the solution to question 35, on the third line from the end, change $CV_s$ to $CV_s^2$.

[11/29/2010] On page 1227, in the solution to question 3, the final answer should be 0.3348.

[11/30/2010] On page 1248, the solution to question 33 should indicate that all survival functions and probabilities are conditional on $X>500$. A revised solution follows:

It is a little confusing that payment amounts rather than loss amounts are given.

Let $X$ be the loss random variable. Considering payments from all three coverages, we have

| $y_i$ | $r_i$ | $s_i$ | $\hat{S}_X(y_i \mid X>500)$ | $\Pr(X=y_i \mid X>500)$ |
|---|---|---|---|---|
| 1500 | 10 | 1 | 0.9 | 0.1 |
| 3000 | 9 | 2 | 0.7 | 0.2 |
| 3500 | 7 | 1 | 0.6 | 0.1 |
| 5000 | 6 | 3 | 0.3 | 0.3 |

The last column, $\Pr(X=y_i)$, is computed as differences of the survival functions. For example,

$$\Pr(X=3000)=\Pr(X\geq 3000)-\Pr(X>3000)=S_X(3000^- \mid X>500)-S_X(3000 \mid X>500)=0.9-0.7=0.2$$

Notice that the survival function can only be computed conditional on the loss being greater than 500, since there is no data for losses below 500.

Let $Y^P$ be the average payment on the first coverage, which has a deductible of 500 and a maximum covered loss of 5000. The average payment is the sum of the probabilities times the amounts of the payments, taking into account that the payment is 4500 for any loss above 3500 (since such a loss is always 5000 or higher):

$$\begin{aligned}\mathbf{E}[Y^P] &= \sum_{x<3500}(x-500)\Pr(X=x \mid X>500)+4500S(3500 \mid X>500)\\ &= 0.1(1000)+0.2(2500)+0.1(3000)+0.6(4500)=\boxed{\mathbf{3600}} \qquad \textbf{(D)}\end{aligned}$$

Alternatively, you can integrate the survival function from 500 to 5000:

$$\begin{aligned}\mathbf{E}[Y^P] &= \int_{500}^{5000} S_X(x \mid X>500)\mathrm{d}x \\ &= \int_{500}^{1500} 1\,\mathrm{d}x + \int_{1500}^{3000} 0.9\,\mathrm{d}x + \int_{3000}^{3500} 0.7\,\mathrm{d}x + \int_{3500}^{5000} 0.6\,\mathrm{d}x \\ &= 1000 + 0.9(1500) + 0.7(500) + 0.6(1500) = \boxed{\mathbf{3600}}\end{aligned}$$

[10/25/2011] On page 1250, the solution to question 4 is incorrect. The correct solution is

A payment of 2500 for the first coverage is equivalent to a loss of 3000. The likelihood of 3000, or the density of a loss of 3000 is

$$f(3000) = \frac{2(2000^2)}{5000^3} = 6.4 \times 10^{-5}$$

A payment of 2500 for the second coverage is equivalent to a loss of 3500. The likelihood of 3500, or the density of a loss of 3500 given that it is greater than 1000 is

$$f(3500) = \frac{2(2000^2)}{5500^3} = 4.80841 \times 10^{-5}$$

The question is asking for the average size of the next payment, so it is asking for the average payment per payment, or the mean excess loss. For a Pareto, the mean excess loss at $d$, by equation **??**, is $e(d) = (\theta + d)/(\alpha - 1)$. Thus, for a deductible of 500, the mean excess loss is $(2000+500)/1 = 2500$, and for a deductible of 1000 the mean excess loss is $(2000+1000)/1 = 3000$. We weight these by the product of the prior (2/3 vs. 1/3) and the likelihoods. The expected claim given a payment of 2500 is then

$$\frac{(2/3)(6.4 \times 10^{-5})(2500) + (1/3)(4.80841 \times 10^{-5})(3000)}{(2/3)(6.4 \times 10^{-5}) + (1/3)(4.80841 \times 10^{-5})} = \boxed{\mathbf{2636.54}} \qquad \textbf{(A)}$$

[2/15/2011] On page 1250, in the solution to question 5, $K$ is defined as negative what is shown in the solution, or $-6.7709$. Then $\hat{\alpha} = -n/K$, so it would still have the same value as shown in the solution.

[12/1/2010] On page 1253, in the solution to question 12, on the first displayed line, move the first 0 into the upper limit of the integral:

$$\int_0^{10} x\left(\frac{x-6}{16}\right)$$

[2/23/2011] On page 1258, in the solution to question 29, on the first displayed line, $2\sigma^2$ should be in the exponent as follows:

$$\frac{1}{\sigma x\sqrt{2\pi}} e^{-(\ln x - \mu)^2/2\sigma^2}$$

Four lines from the end, a summation sign is missing under the radical: $\sqrt{\sum(\ln x_i - 2)^2/5}$.

[9/27/2011] On page 1259, in the solution to question 31, on the second line, change the $z^2$ in the numerator to $z$.

[5/3/2010] On pages 1282–1283, the solution to question 21 is incorrect. The correct solution is

You may either do this by recognizing the distributions or by calculating $P_S'(0)$.

By looking at the tables, you can recognize $P_N(z)$ as from a negative binomial with $r = 3$, $\beta = 2$. $P_X(z)$ looks like a zero-truncated negative binomial with $r = 1$, $\beta = 3$, except that the denominator is 3 instead of 0.75, and 0.75 is

added. So the probabilities for this distribution are 1/4 of the corresponding probabilities for a zero-truncated distribution, and the probability of 0 is 0.75, which means that it is zero-modified with $p_0^M = 0.75$. We can handle the aggregate distribution by modifying the frequency distribution to be the frequency of non-zero losses and modifying the severity distribution to condition it on non-zero losses. The negative binomial frequency is modified by multiplying $\beta$ by the probability that a loss is greater than 0, which is 0.25. The resulting negative binomial has $r = 1$, $\beta = 0.5$. The severity is modified by truncating 0, turning it into a zero-truncated geometric.

The probability that the modified frequency is 1 equals:

$$p_1 = \Pr(N=1) = 3\left(\frac{1}{1+\beta}\right)^r\left(\frac{\beta}{1+\beta}\right) = 3\left(\frac{1}{1+0.5}\right)^3\left(\frac{0.5}{1.5}\right) = \frac{8}{27}$$

$\Pr(X=1)$ for a zero-truncated geometric is the same as $\Pr(X=0)$ for the corresponding untruncated geometric. Our geometric has $\beta = 3$.

$$f_1 = \Pr(X=1) = \left(\frac{1}{1+\beta}\right) = \frac{1}{4}$$

The probability of aggregate losses of 1 is therefore

$$\Pr(S=1) = \Pr(N=1)\Pr(X=1) = \left(\frac{8}{27}\right)\left(\frac{1}{4}\right) = \boxed{\frac{\mathbf{2}}{\mathbf{27}}} \qquad \textbf{(B)}$$

Alternatively, we can calculate $P_S'(0)$. To calculate $P_S'(0)$, use $P_S = P_N(P_X)$. To differentiate, use the chain rule.

$$\begin{aligned}
P_N(z) &= \big(1-2(z-1)\big)^{-3} \\
P_N'(z) &= (2\cdot 3)\big(1-2(z-1)\big)^{-4} \\
P_X(z) &= 0.75 + \frac{(4-3z)^{-1} - 0.25}{3} \\
P_X(0) &= 0.75 \\
P_X'(z) &= \frac{1}{(4-3z)^2} \\
P_S'(0) &= \left(\frac{6}{\big(1-2P_X(0)\big)^4}\right)\left(\frac{1}{\big(4-3(0)\big)^2}\right) \\
&= \left(\frac{6}{1.5^4}\right)\left(\frac{1}{4^2}\right) = \left(\frac{32}{27}\right)\left(\frac{1}{16}\right) = \boxed{\frac{\mathbf{2}}{\mathbf{27}}} \qquad \textbf{(B)}
\end{aligned}$$

[10/9/2011] On page 1283, in the solution to question 22, on the fourth line, reverse 10.5 and 11.5 on the left side: $\mathbf{E}[(S-10.5)_+] - \mathbf{E}[(S-11.5)_+]$

[9/21/2010] On page 1293, the solutions to questions 20 and 21 should be interchanged.

[11/4/2010] On page 1299, on the 3rd line of the page, the bias is $-1/11\theta$, not $-1/\theta$.

[10/10/2010] On page 1309, in the solution to question 16, on the last line of the page, add a factor $n_0$ before $\frac{N-P}{P}$.

[7/26/2010] On page 1326, in the solution to question 9, on the second to last line, replace $\frac{\theta a}{b}$ with $\frac{\theta a}{a+b}$.

[6/23/2011] On page 1331, in the solution to question 33, two lines after the itemized list, replace "$a = 10, \ldots 10\big(\frac{9}{9+11}\big) =$ $\boxed{\mathbf{5.50}}$" with "$a = 12$, $b = 10$, and mode $10\big(\frac{11}{11+9}\big) =$ $\boxed{\mathbf{5.50}}$".

[3/4/2011] On page 1331, in the solution to question 34, on the second line, after "distribution mean", add "squared".

[4/27/2010] On page 1335, in the solution to question 10, on the second displayed line, change $\theta \ln 0.5$ to $-\theta \ln 0.5$.

[7/18/2010] On page 1336, in the solution to question 14, on the first displayed line, remove the product symbol in the denominator. On the third displayed line, change the $\sum \ln(x_i+7)+\sum \ln(x_i+3.1)$ to $\sum \ln(x_i+7)-\sum \ln(x_i+3.1)$

[8/31/2010] On page 1344, change the entry for Spring 2007 question 36 from 46 to 48.

[8/12/2010] On page 1346, Practice Exam 3:34's lesson should be 49, not 48.

[6/20/2011] On page 1348, the table omits the correspondence of questions 283–289. They correspond to questions M-F06: 22,29,30,31,32,39, and 40 respectively, whose solutions are found on pages 1322–1323.