VOLUME I

Page AS-16, line 4 should be
. . . the p-value is \( P[\chi^2(5) > 15.1] = .01 \) (from the chi-square table).

Page AS-66, Example AS-16 Solution,
in the final line the last vector should be
\[
\begin{bmatrix}
- .25 \\
2 \\
1.25 
\end{bmatrix}
\]

Page AS-116, The White Test, line 3 should be
. . . \( W_i = \gamma + \delta Z_i + v_i \) . . .

Page AS-202, #15, line 2 should be
\( \theta = 0.6; \; \sigma^2 = 4.0. \)

VOLUME II

Page LS-46, Example LS-13, Solution line 1 should be
\( \hat{H}(t) = 0 \) for \( 0 \leq t < 1 \)

Page LS-78, Example LS-23, line 6 should be
- A total of 75 losses that exceed \( k \) have been recorded on Type Y policies.

Page LS-97, #20, Answer should be A

Page LS-102, line 3 should be
\[
t_{|u} \hat{q}_0 = S_n(t) - S_n(t + u) = \frac{n_t - n_{t+u}}{n} = \frac{\text{number of deaths between times } t \text{ and } t+u}{\text{number alive at time } 0} = \hat{p},
\]
Page LS-105, in the two lines before the estimated variance of the Nelson-Aalen estimate of $H(y_j)$ the estimated variance of $S_n(k)$ should be $\frac{S_n(k)[1-S_n(k)]}{n_0}$ in both lines.

Page LS-135, Example LS-40, line 5 should have $\hat{\alpha} = 2$ (not 3)

LS-139, #5, the data table should be

<table>
<thead>
<tr>
<th>#</th>
<th>0</th>
<th>1</th>
<th>2 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
<td>800</td>
<td>180</td>
<td>20</td>
</tr>
</tbody>
</table>

LS-144, #5 solution should be

There are 3 categories (rather than intervals), $X = 0$, $X = 1$ and $X \geq 2$.

From the data set we have # in category 1 (# of 0's) = 800,
# in category 2 (# of 1's) = 180 and # in category 3 (# $\geq 2$) = 20.

The Poisson probability function is $P[X = k; \lambda] = \frac{e^{-\lambda} \lambda^k}{k!}$. The $E_j$ values (expected numbers for each category) are

$E_1 = 1000P[X = 0; .2] = 1000\frac{e^{-2(.2)^0}}{0!} = 818.7$,

$E_2 = 1000P[X = 1; .2] = 1000\frac{e^{-2(.2)^1}}{1!} = 163.7$,

$E_3 = 1000P[X \geq 2; .2] = 1000[1 - (.8187 + .1637)] = 17.6$.

$Q = \frac{(818.7-800)^2}{818.7} + \frac{(163.7-180)^2}{163.7} + \frac{(17.6-20)^2}{17.6} = 2.38$. Answer: D

Page LS-147, middle of page the ratio $\frac{C_i}{C_j}$ should be $\frac{C_i}{C_k}$

Page LS-148, second line from the bottom of the page $S_0(ty)$ should be $S_0(y)$ and $f_0(ty)$ should be $f_0(y)$.

Page LS-151, the title at the top of the page should be

Breslow's partial likelihood when there are ties for death times
Page LS-151, Example LS-43 (continued), Solution should be

With $\hat{\beta} = - .75$, the baseline hazard rate is:

for $1 \leq t < 2$, $\hat{H}_0(t) = \frac{s_1}{c_1 + \cdots + c_{12}} = \frac{1}{6 + 6e^{\beta}} = .113$ ,

for $2 \leq t < 3$, $\hat{H}_0(t) = \frac{s_1}{c_1 + \cdots + c_{12}} + \frac{s_2}{c_2 + \cdots + c_{12}} = \frac{1}{6 + 6e^{\beta}} + \frac{1}{5 + 6e^{\beta}} = .241$ ,

for $3 \leq t < 4$, $\hat{H}_0(t) = \frac{s_1}{c_1 + \cdots + c_{12}} + \frac{s_2}{c_2 + \cdots + c_{12}} + \frac{s_3}{c_3 + \cdots + c_{12}}$

$= \frac{1}{6 + 6e^{\beta}} + \frac{1}{5 + 6e^{\beta}} + \frac{1}{4 + 6e^{\beta}} = .387$ , etc.

Page LS-153, #3 and 4 intro should read

Questions 3 and 4 are based ...

Page LS-154, #2, second line should be

... $\hat{H}_0(t) = \sum_{i \leq t} \sum_{i \in R(j)} \frac{s_j}{c_i}$ ...

The solution to #3 should be

3. We are to find \( P[N_2 = 0|N_1 = 0] = \frac{P[(N_2=0) \cap (N_1=0)]}{P[N_1=0]} \).

Then \( P[N_1 = 0] \) and \( P[(N_2 = 0) \cap (N_1 = 0)] \) are found by conditioning over driver type.

\[
P[N_1 = 0] = P[N_1 = 0|G] \cdot P[G] + P[N_1 = 0|B] \cdot P[B],
\]

where \( G \) and \( B \) denote the event that the randomly selected driver is good or bad, and \( P[G] = .75, P[B] = .25 \) were given. Since good drivers have Poisson parameter 0.2, we get \( P[N_1 = 0|G] = e^{-2} \).

The Poisson parameter for bad drivers is distributed uniformly from 1 to 2, so \( P[N_1 = 0|B] \) is found by conditioning over the Poisson parameter:

\[
P[N_1 = 0|B] = \int_1^2 P[N_1 = 0|B, \lambda] \cdot f(\lambda) \, d\lambda = \int_1^2 e^{-\lambda} \cdot (1) \, d\lambda = e^{-1} - e^{-2}.
\]

Then \( P[N_1 = 0] = (e^{-2})(.75) + (e^{-1} - e^{-2})(.25) = .6722 \).

In a similar way we can find \( P[(N_2 = 0) \cap (N_1 = 0)] \).

\[
P[(N_2 = 0) \cap (N_1 = 0)] = P[(N_2 = 0) \cap (N_1 = 0)|G] \cdot P[G] + P[(N_2 = 0) \cap (N_1 = 0)|B] \cdot P[B].
\]

It is implicitly assumed that for a randomly chosen driver with a particular value of \( \Lambda \), the numbers of claims in separate years are independent of one another. Therefore,

\[
P[(N_2 = 0) \cap (N_1 = 0)|G] = P[N_2 = 0|G] \cdot P[N_1 = 0|G] = (e^{-2})(e^{-2}) = .6703.
\]

\[
P[(N_2 = 0) \cap (N_1 = 0)|B] = \int_1^2 P[N_1 = 0|B, \lambda] \cdot P[N_2 = 0|B, \lambda] \cdot f(\lambda) \, d\lambda = \int_1^2 e^{-2\lambda} \cdot (1) \, d\lambda = \frac{1}{2}(e^{-2} - e^{-4}) = .0585.
\]

Then, \( P[(N_2 = 0) \cap (N_1 = 0)] = (.6703)(.75) + (.0585)(.25) = .5174 \).

Finally, \( P[N_2 = 0|N_1 = 0] = \frac{P[(N_2=0) \cap (N_1=0)]}{P[N_1=0]} = \frac{.5174}{.6722} = .769 \). Answer: B
Page PE2-4, #11 should read as follows
11. A school board is administering a standardized math test to students in a large number of schools. The board estimated that the grade of a student is normally distributed with mean $\theta$ and standard deviation 10, where $\theta$ varies from one school to another, but is constant for all students within a school. The board also estimates that $\theta$ is normally distributed with a mean of 70 and a standard deviation of 5. A particular school has 30 students taking the test and it is found that the average grade for those 30 students is 65. The school board uses Bayesian analysis to determine the posterior distribution of $\theta$ for students in that school. Find the mean of that posterior distribution.

Page PE2-7, #22, should be
A mortality study has right-censored data. The first time at which deaths occur is $t_1$ and you are given the variance of the product-limit estimate at $t_1$ and variance of the Nelson-Aalen estimate of the cumulative hazard rate at time $t_1$ are $\text{Var}[S_n(t_1)] = .004580$ and $\text{Var}[\hat{H}(t_1)] = .005844$. Find the product-limit estimate of the survival probability to time 1.
A) .63 B) .68 C) .73 D) .78 E) .83

Page PE2-11, #11 should read as follows
11. A school board is administering a standardized math test to students in a large number of schools. The board estimated that the grade of a student is normally distributed with mean $\theta$ and standard deviation 10, where $\theta$ varies from one school to another, but is constant for all students within a school. The board also estimates that $\theta$ is normally distributed with a mean of 70 and a standard deviation of 5. A particular school has 30 students taking the test and it is found that the average grade for those 30 students is 65. The school board uses Bayesian analysis to determine the posterior distribution of $\theta$ for students in that school. Find the mean of that posterior distribution.

Page PE2-20, solution to #15, last two lines should be
within 10% of expected number of claims per year is $2(.9874) - 1 = .9748$ of the time. Answer: D
Page PE2-22, solution to #22 should be
\[V \hat{\alpha}[S_n(t_1)] = (1 - \frac{s_1}{r_1})^2 \cdot \frac{s_1}{r_1(r_1-s_1)} = \frac{s_1(r_1-s_1)}{r_1^2} \text{ from Greenwood's formula and}
\]
\[V \hat{\alpha}[\bar{H}(t_1)] = \frac{s_1}{r_1^2}, \text{ so that}
\]
\[\frac{V \hat{\alpha}[S_n(t_1)]}{V \hat{\alpha}[\bar{H}(t_1)]} = 1 - \frac{s_1}{r_1} = S_n(t_1) = \frac{100458}{100584} = .784. \text{ Answer: D}
\]

Page PE3-9, #23 Answers should be
A) 300 B) 400 C) 500 D) 600 E) 700

Page PE3-22, #23 solution should be
23. The maximum insurer payment is 2000.
The empirical estimate of the expected cost per loss is
\[\frac{1}{100} \left[33\left(\frac{1000+1500}{2} - 1000\right) + 15\left(\frac{1500+2000}{2} - 1000\right) + 11\left(\frac{2000+3000}{2} - 1000\right) + 2(2000)\right] = 400. \]
Alternatively, the expected cost per loss is \(E[X \wedge 3000] - E[X \wedge 1000]\) and the empirical estimate is
\[E[X \wedge 3000] - E[X \wedge 1000] = \frac{1}{100}\left[12\left(\frac{0+500}{2}\right) + 27\left(\frac{500+1000}{2}\right) + 33\left(\frac{1000+1500}{2}\right) + 15\left(\frac{1500+2000}{2}\right) + 11\left(\frac{2000+3000}{2}\right) + (2)(3000)\right] - \frac{1}{100}\left[12\left(\frac{0+500}{2}\right) + 27\left(\frac{500+1000}{2}\right) + (33 + 15 + 11 + 2)(1000)\right] = 1242.5 - 842.5 = 400. \text{ Answer: B}
\]
Page PE5-21, #31 Solution, line 4 should be
\[\left(\frac{2}{7}\right)^2 \left[1 + \frac{\text{Var}[Y]}{(E[Y])^2}\right] = 2166, \text{ where } Y \text{ is the severity distribution.}
\]
Page PE6-12, #36 answers should be
A) 1.6 B) 1.7 C) 1.8 D) 1.9 E) 2.0
10. The contribution to the partial likelihood function from the 3 deaths at time 1 is \( e^{2\beta} \left( \frac{1}{100 + 100e^\beta} \right)^3 \), since there are 100 at risk of each type and 2 deaths of type 1 and 1 death of type 0.

The contribution to the partial likelihood function from the 4 deaths at time 1 is \( \frac{1}{(99 + 98e^\beta)^4} \), since there are 99 at risk of type 0 and 98 at risk of type 1 and 4 deaths of type 0 (total of 4 deaths; this is the exponent in the denominator).

The contribution to the partial likelihood function from the 5 deaths at time 1 is \( \frac{e^{2\beta}}{(95 + 98e^\beta)^5} \), since there are 95 at risk of type 0 and 98 at risk of type 1 and 2 deaths of type 1 and 3 deaths of type 0 (total of 5 deaths).

The partial likelihood function is
\[
L(\beta) = e^{2\beta} \left( \frac{1}{100 + 100e^\beta} \right)^3 \cdot \frac{1}{(99 + 98e^\beta)^4} \cdot \frac{e^{2\beta}}{(95 + 98e^\beta)^5},
\]
and the log likelihood function is
\[
\ln L(\beta) = 4\beta - 3 \ln(100 + 100e^\beta) - 4 \ln(99 + 98e^\beta) - 5 \ln(95 + 98e^\beta).
\]
\[
\ln L(-.5) = -62.7. \quad \text{Answer: B}
\]

Page PE6-27, #36 solution, last 3 lines should be
99% upper limit is \( \hat{\beta} + s_{\hat{\beta}} \cdot t_{.005}(3) = \hat{\beta} + 5.841 s_{\hat{\beta}} \)
\[
= \hat{\beta} + 3.182 s_{\hat{\beta}} + (5.841 - 3.182) s_{\hat{\beta}} = 1.453 + .564 = 2.0.
\]
Answer: E

Page PE6-27, #38 Solution, last 3 lines should be
\[
\theta' = \frac{\alpha}{\alpha + 1} = \frac{1}{m + \alpha}. \quad \text{For a Poisson model distribution the predictive mean is the same as the expected value of the posterior. Therefore the predicted number of claims in the } m + 1\text{-st period is } \alpha' \theta' = (1 + n) \left( \frac{1}{m + \alpha} \right) = \frac{n + 1}{m + \alpha}. \quad \text{Answer: E}
\]

Page M01-21, #16, line 5
upper limit of the summation should be 101 (not 100)

Page N01-4, #7,
the probability of heads for coins 1-4 should be .5

Page N01-7, #15, \( \beta \) should be .2 (not .02)
Page N01-11, #26, Answer (C) should be
At least 11.5, but less than 12.5

Page N02-9, #29,
in the table, the probability that $X = 0$ given $\Theta = 1$ should be .1 (not .2)

Page N02-16, #4, line 3
$\frac{1}{n+\frac{1}{2}}$ should be $\frac{1}{n-\frac{1}{2}}$

Page N02-16, November 2002 SOA/CAS exam, #7 solution.
The solution presented in the manual results in a different answer (D) from that
listed as the correct answer (C) in the SOA exam. In order to get answer C, an additional
assumption must be made. The following is the solution resulting in answer C.

From the information given we have $\mu = E[X] = (1 + 2 + 3)(\frac{1}{3}) = 2$ and
$E[X^2] = (1^2 + 2^2 + 3^2)(\frac{1}{3}) = \frac{14}{3}$ so that $Var[X] = E[X^2] - (E[X])^2 = \frac{2}{3}$.

We interpret the given information as $E[X|\Theta] = \begin{cases} 1.5 & \text{Prob. 2/3} \\ 3 & \text{Prob. 1/3} \end{cases}$
so that $a = Var(E[X|\Theta]) = [(1.5)^2(\frac{2}{3}) + (3)^2(\frac{1}{3})] - [(1.5)(\frac{2}{3}) + (3)(\frac{1}{3})]^2 = .5$.
Then we use the conditional probability rule $Var[X] = E[Var[X|\Theta]] + Var[E[X|\Theta]]$
to get $v = E[Var[X|\Theta]] = Var[X] - Var[E[X|\Theta]] = \frac{2}{3} - .5 = \frac{1}{6}$.
Since there is $n = 1$ observation, the Buhlmann credibility factor is $Z = \frac{1}{1+\frac{1}{16}} = \frac{3}{4}$.

The Buhlmann credibility premium is $Z\bar{X} + (1-Z)\mu = (\frac{3}{4})(1) + (\frac{1}{4})(2) = \frac{5}{4}$.
Answer: C

Page N02-27, solution to #39, 4th line from bottom should be
$E[X_2|\text{Class 2}] = ...$