

## Errata and Updates for ASM Exam MAS-II (First Edition) Sorted by Date

Practice exam 4:7 is defective in that none of the answer choices are correct. Note the corrections to practice exam 4:22, page 591 and 4:38, page 597. In practice exam 6:39, the correct answer is far outside the range of the answer choices.

- [9/9/2021] On page 458, in the solution to exercise 37.15, the signs of the  $\varepsilon_i$  in the table should be reversed; they should also be reversed in the two fractions two and five lines below the table. Thus the table and the following lines should read:

$X_i$ in training set	Nearest two points	Fitted value	$Y_i$	$\varepsilon_i$
4	4,12	$\frac{3+15}{2} = 9$	3	-6
7	4,12	$\frac{3+15}{2} = 9$	8	-1
12	12,14	$\frac{15+22}{2} = 18.5$	15	-3.5
14	14,15	$\frac{22+30}{2} = 26$	22	-4
15	14,15	$\frac{22+30}{2} = 26$	30	4
21	15,22	$\frac{30+53}{2} = 41.5$	40	-1.5
22	15,22	$\frac{30+53}{2} = 41.5$	53	11.5

The MSE on the training data is

$$\frac{(-6)^2 + (-3.5)^2 + (-4)^2 + 4^2 + 11.5^2}{5} = \boxed{42.5}$$

We divide by 5 since no parameters are estimated.

The MSE on the test data is

$$\frac{(-1)^2 + (-1.5)^2}{2} = \boxed{1.625}$$

- [9/9/2021] On page 465, in formula (38.5), a 2 is missing from the numerator. The formula is

$$\text{Residual mean deviance} = -\frac{2 \sum_m \sum_k n_{mk} \ln \hat{p}_{mk}}{n - |T|}$$

- [9/9/2021] On page 507, in the sidebar, 2–3 lines below the displayed equation, switch  $i$  and  $i^*$ : “once for each  $i$  (for the first summand) or for each  $i^*$  (for the second summand)”.

- [8/24/2021] On page 493, exercise 39.6, while the exercise can be worked out, the second and third bullets are false. The first principal component loading for  $X_1$  is  $1/\sqrt{2}$ , and the first principal component loading for  $X_2$  is negative.

- [8/22/2021] On page 127, in exercise 12.15, in the fourth through sixth bullets, change “Risk group R” to “Risk group T”.

- [8/22/2021] On page 127, in exercise 12.16, on the tenth line, change “Group SR” to “Group S”.

- [8/3/2021] On page 364, in equation (33.1), change  $\theta_{\text{prop}}$  to  $p(\theta_{\text{prop}})$  and  $\theta_{\text{curr}}$  to  $p(\theta_{\text{curr}})$ , where  $p$  is the prior density function.

[8/3/2021] On page 366, in equation (33.1), the right parenthesis after “Data” in the denominator should be moved to after  $\theta_{\text{curr}}$ , also in the denominator. The difference is  $130.0 - 128.2 = \boxed{1.8}$ . AIC is lower.

[7/23/2021] On page 159, in the solution to exercise 14.14, replace the first two lines with:

Expected claims are  $0.2(1800) = 360$ . The limited fluctuation estimate is based on a credibility factor of  $Z = \sqrt{360/1083} = 0.5766$ , and is

$$0.5766 \left( \frac{200}{1800} \right) + (1 - 0.5766)(0.2) = 0.1488$$

Replace the last line with:

The percentage change is  $0.1724/0.1488 - 1 = \boxed{+15.91\%}$ . (E)

[5/19/2021] On page 76, in the solution to exercise 7.9, on the first three displayed lines, change every  $x$  to  $q$ :  $f(x)$  should be  $f(q)$  and  $dx$  should be  $dq$ . Four changes.

[5/19/2021] On page 118, one line above the heading “The exposure unit”, insert “are” between “you” and “calculating”.

[4/30/2021] On page 38, in exercise 4.5, on the first line in typewriter font (the seventh line of the question), change  $\lambda$  to  $\lambda$ s.

[4/27/2021] On page 503, in the solution to exercise 39.12, replace II with

When a variable is scaled, it is divided by its standard deviation to make the variance 1. Since the first principal component has maximal variance, it will put lower loading on variables with lower variance. The higher the variance of the original variable, the greater the reduction in loading.

Comparing the unscaled and scaled biplots, we see that X3’s loading on the first principal component was significantly decreased whereas the loadings of the other variables on the first principal component were increased. We conclude that X3 has the highest variance. ✓

[4/27/2021] On page 504, replace the solution to exercise 39.20 with

I. I can be deduced. ✓

II. It is not clear whether Sue sold a lot of dental insurance or had a high first principal component score because she sold a lot of life or health insurance. ✗

III. Bob may have sold a lot of life insurance but very little health and dental. ✗ (E)

[4/27/2021] On page 573, in question 24, change the fourth line to  $\text{logit}(p_i) = \alpha + \beta T_i$ .

[4/22/2021] On page 303, on the third line of the page, change 15 to 5.

[4/18/2021] On page 736, replace the solution to question 40 with

We multiply the first row of the loading matrix, the loadings of the first variable on the three principal components, by the scores of the three principal components.

$$x_{11} \approx 1.220(0.732) + 0.002(0.437) - 1.279(-0.523) = \boxed{1.563} \quad (\text{E})$$

[4/16/2021] On page 430, on the seventh line of the page, change  $K(K - 1)$  to  $K(K - 1)/2$ .

[4/13/2021] On page 457, in the solution to exercise 37.10, on the first line, change “so in Model I  $Y = P$ ” to “so in Model I  $Y = U$ ”. On the last line, change “one N” to “two Ns”.

[4/11/2021] On page 591, replace question 22 with

$X$  has a Bernoulli distribution with  $q = 0.4$ .

Calculate the information entropy of 20 observations of  $X$ .

[4/11/2021] On page 720, in the solution to question 3, on the third line, change  $\sigma_{HM}^2$  to  $\sigma_{HM}^2$ .

[4/8/2021] On page 269, in the solution to Example 25A, on the first line, change  $\hat{\beta}_0 = \frac{5}{7}$  to  $\hat{\beta}_1 = \frac{5}{7}$ .

[4/8/2021] On page 711, in the solution to question 39, change the answer key to **(B)**. Make the same change in the answer key on page 733.

[4/7/2021] On page 314, in the solution to exercise 18.12, replace the fourth line (equation (\*)) and everything after it with

$$0.5a \frac{2}{0.3} a + 0.5(1-b) \frac{2}{0.7} (1-b) = \frac{a^2}{0.3} + \frac{(1-b)^2}{0.7} \quad (*)$$

Also,  $p(a) = 2a/0.3$  and  $p(b) = 2(1-b)/0.7$ , and they are equal, so

$$\frac{a}{0.3} = \frac{1-b}{0.7}$$

$$1-b = \frac{7}{3}a$$

Set (\*) equal to 0.1 and substitute  $\frac{7}{3}a$  for  $1-b$  and we get

$$\frac{a^2}{0.3} + \frac{\left(\frac{7}{3}a\right)^2}{0.7} = 0.1$$

$$\frac{100}{9}a^2 = 0.1$$

$$a = \boxed{0.09487}$$

$$b = 1 - \frac{7}{3}a = \boxed{0.77864}$$

[3/23/2021] On page 297, in the last paragraph, lines 3–4, change the two sentences beginning with “Covariance” to  
Covariance of two observations of the same student with different teachers is  $a$ . Covariance of two observations of the same teacher with different students is  $b$ .

[3/22/2021] On page 297, on the third line from the end of the page, change  $b + c$  to  $a + b$ .

[3/15/2021] On page 174, two lines from the bottom, a sum sign is missing from the numerator. The line should be

$$= \frac{\sum_{j=1}^n m_j^2 (\beta + a/m_j)}{m^2}$$

[3/15/2021] On page 175, two lines from the bottom of the sidebar, change  $v(n-1)$  to  $v(r-1)$ .

[3/15/2021] On page 187, in the solution to exercise 16.6, on the line for  $\sigma_{HM}^2$ , change  $\frac{2163}{3}$  to  $\frac{2163}{8}$ .

[2/28/2021] On page 4, in the solution to Example 1A, change 500 to 5000 in the five places that it appears. In other words, on the first line change  $(500 - a, 500 + a)$  to  $(5000 - a, 5000 + a)$ ; change  $(500 + a, \infty)$  to  $(5000 + a, \infty)$ . On the second line change  $(-\infty, 500 - a)$  to  $(-\infty, 5000 - a)$  and change  $500 + a$  to  $5000 + a$ .

[2/13/2021] On page 392, in the solution to exercise 33.9, change the final answer from 35 to 36.

[1/16/2021] On page 703, in the solution to question 37, change II and III to:

2. All we know is that when the clusters were {1}, {2}, {3}, {4}, and {5,6,7}, {4} was fused with {5,6,7}. So {4} is closer to the centroid of {5,6,7} than {3} is, and {4} is closer to the centroid of {5,6,7} than it is to {3}. None of these imply II. ✗
3. All we know is that {3} is closer to the centroid of {4,5,6,7} than {1} is to {2}, since it was fused first. That doesn't imply III. ✗

[12/26/2020] On page 21, in the solution to exercise 2.2, on the second displayed line, change the left hand side from  $\mu_X$  to  $\sigma_X^2$

[12/26/2020] On page 29, in exercise 3.8, on the first line, change “iimited” to “limited”.

[12/26/2020] On page 39, in exercise 4.6, on the first line, change “te” to “the”.

[12/26/2020] On page 211, in the matrix under the second bullet *First order autoregressive*, on the last row, the first two entries should be interchanged. The correct matrix is

$$\begin{pmatrix} \sigma^2 & \sigma^2\rho & \dots & \sigma^2\rho^{n_i-1} \\ \sigma^2\rho & \sigma^2 & \dots & \sigma^2\rho^{n_i-2} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma^2\rho^{n_i-1} & \sigma^2\rho^{n_i-2} & \dots & \sigma^2 \end{pmatrix}$$

[12/26/2020] On page 220, in the first matrix in the solution to Example 19B, change the 97 in the upper right corner to 95.

[12/26/2020] On page 251, in exercise 22.4, on the third line, change  $u_{0j}i$  to  $u_{0j}$ ; delete the  $i$ .

[12/26/2020] On page 289:

- In exercise 26.1, in the third bullet under Model Structure XYZ, delete “that variance”, so that the sentence reads “...that the variance by treatment can ...”.
- In exercise 26.2, in the third bullets under both model structures, delete “that variance”.

[12/26/2020] On page 290, in exercise 26.3(III), change “treatment” to “treatment”.

[12/26/2020] On page 290, in exercise 26.5, on the second line, change “espected” to “expected”.

[12/26/2020] On page 292, in the solution to exercise 26.1, on the second line of the second paragraph, change “ae” to “are”.

[12/26/2020] On page 325, in the third paragraph of Section 30.1, on the third line, change “marriage age (model m5.2)” to “marriage rate (model m5.2)”.

[12/26/2020] On page 358, in the solution to exercise 31.10, on the first line, change “date set” to “data set”. Four lines from the end, replace “regularizing” with “regularizing”.

[12/26/2020] On page 371, in exercise 32.12, change answer choice D to

$$D. \sigma_2^2 > \sigma_3^2 > \sigma_1^2$$

[12/26/2020] On page 392, in the solution to exercise 33.11, change the final answer 1.1073 to 1.1069.

[12/26/2020] On page 403, in exercise 34.6, two lines from the end, delete “= ” after “Let”.

[12/26/2020] On page 424, in the list item “2. *No pooling*”, on the fourth line, change  $\alpha_{\text{CITY}}$  to  $\alpha_{\text{CITY}}$ .

[12/26/2020] On page 427, in the third paragraph on the page, on the third line, change “sigma\_actor isn't” to “sigma\_block isn't”.

- [12/26/2020] On page 439, in the numbered list, item 2, change “parametrizaton” to “parametrization”.
- [12/26/2020] On page 440, in exercise 36.10, in Model II, change the third line from  $\alpha_{\text{SCHOOL}} \sim \text{Normal}(0, 2\sigma)$  to  $\alpha_{\text{SCHOOL}} \sim \text{Normal}(\alpha, 2\sigma)$ . Also, change answer choice D to “Model II and Model III only”.
- [12/26/2020] On page 442, in the solution to exercise 36.9, on the first line, change “correlation” to “covariance”.
- [12/26/2020] On page 491, in exercise 39.1 statement I, on the left side, change  $\phi_{ji}$  to  $\phi_{j1}$ .
- [12/26/2020] On page 717, in the solution to question 31, on the third line, change  $L(2 | e^{0.8})-$  to  $L(2 | e^{0.8})=$ .
- [12/26/2020] On page 745, in the solution to question 39, a “2” is missing from the equation, and a negative sign is missing from the solution. Replace the second line with

$$-2 \left( \frac{45 \ln \frac{45}{55} + 10 \ln \frac{10}{55} + 32 \ln 0.8 + 8 \ln 0.2 + 10 \ln 0.25 + 30 \ln 0.75 + 5 \ln 0.1 + 45 \ln 0.9 + 3 \ln \frac{3}{55} + 52 \ln \frac{52}{55}}{240 - 5} \right) = \boxed{-0.8211} \quad (\text{A})$$

- [12/20/2020] On page 503, in the solution to exercise 39.11, replace the second paragraph with
- Abigail has a negative score from the first component. But we cannot tell whether that is because she purchases more food than the average customer or because she purchases less clothes, linen, and appliances than the average customer. We cannot conclude II.

Change the answer key to **(E)**.

- [12/19/2020] On page 481, in the solution to exercise 38.7, replace the last 5 lines of the solution with

Pruning S leaves 4 terminal nodes, for a cost of  $251 + 11 + 20 + 58 + 4(9) = 376$ .

Pruning T leaves 3 terminal nodes, for a cost of  $209 + 82 + 81 + 3(9) = 399$

Pruning X leaves 4 terminal nodes for a cost of  $86 + 82 + 81 + 4(9) = 286$

Pruning both S and X leaves 3 terminal nodes for a cost of  $251 + 11 + 86 + 3(9) = 375$ .

**(D)**

- [12/19/2020] On page 498, in exercise 39.14, on the seventh line, change  $\sum_{i=1}^{500} x_i^2 = 750$  to  $\sum_{i=1}^{500} z_i^2 = 750$ .
- [11/13/2020] On page 597, in question 38, assume that the means of the 4 variables are 0.
- [11/12/2020] On page 585, in question 7, change  $\text{TREATMENT}_i$  to  $\text{TREATMENT}_j$ . Also change  $u_{0i}$  to  $u_{0j}$  and  $u_{1i}$  to  $u_{1j}$ .
- [11/12/2020] On page 721, in the solution to question 7, change the last two sentences to “The intercept is a level 2 fixed effect, leaving one level 1 effect. Number of degrees of freedom is  $96 - 2 - 12 = \boxed{83}$ .” None of the answer choices is correct.

- [11/11/2020] On page 708, in the solution to question 24, change the formula on the final line to  $20 + 1.60\sqrt{44\frac{4}{9}} = \boxed{30.7}$ . **(E)**

- [11/6/2020] On page 477, in exercise 38.27, on the second line, change  $\lambda = 2$  to  $\lambda = 0.2$ .

- [11/5/2020] On page 467, in exercise 38.4, in the last three split choices, replace  $X_1$  with  $X_2$ , so that they read:

$$\text{III } R_1(2, 0) = \{X | X_2 < 0\} \text{ and } R_2(2, 0) = \{X | X_2 \geq 0\}$$

$$\text{IV } R_1(2, 1) = \{X | X_2 < 1\} \text{ and } R_2(2, 1) = \{X | X_2 \geq 1\}$$

$$\text{V } R_1(2, 2) = \{X | X_2 < 2\} \text{ and } R_2(2, 2) = \{X | X_2 \geq 2\}$$

[10/27/2020] On page 256, replace the solution to exercise 23.3 with

$$\text{ICC} = \frac{77}{105 + 54 + 77} = \boxed{0.326271}$$

[10/15/2020] On page 307, in exercise 28.6, in the table, for Alumni ID 3, change “Years since passing the entrance exam” from 10 to 20.

[10/15/2020] On page 313, in the solution to exercise 28.4, replace the paragraph on page 313 with

Summing up the posterior column we get 0.11940. We may divide the unnormalized posterior by this number to get the normalized posterior. Or we can multiply our desired percentile by this number:  $0.9(0.11940) = 0.10746$ , and then add up the highest values of the unnormalized posterior until they add up to more than this number. We find that adding the values for  $\theta = 4, 5, 6$  results in 0.10715 while adding the values for  $\theta = 4, 5, 6, 7$  results in 0.11426, a sum greater than 0.10715, so the 90% HPDI is  $\boxed{[4, 7]}$ , or  $(a, b)$  where  $3 < a \leq 4$  and  $7 \leq b < 8$ .

[10/15/2020] On page 345, last line, replace “diamonds” with “circles”. On page 346, first line, replace “diamonds” with “circles”. In the third bullet point on that page, first line, replace “diamond” with “circle”.

[10/15/2020] On page 358, replace the solution to exercise 31.14 with

For AIC you start with the deviance at the posterior means. You add twice the number of parameters. There are 3 parameters  $(\alpha, \beta, \sigma)$ , so you’d add 6. AIC is therefore  $122.2 + 6 = 128.2$ .

For DIC, start with the average deviance, 126.1. You add the difference between the average deviance and the deviance at the means. Here, that is  $126.1 - 122.2 = 3.9$ . The result is  $126.1 + 3.9 = 130.0$

[10/15/2020] On page 392, in the solution to exercise 33.7, change the final answer 206.044 to 206.954.

[10/15/2020] On page 414, on the second line of the paragraph under Gamma-Poisson, change “the less” to “the more”.

[10/15/2020] On page 421, replace the fourth and later lines of the solution to exercise 35.11 with

We want to develop the negative binomial. It is easier to do this using the parametrization of the exam tables. With that parametrization,  $\alpha$  is  $\lambda/4 = 0.818731/4 = 0.204683$  and  $\theta = 4$ . The negative binomial then has  $r = 0.204683$  and  $\beta = 4$ . The probability of 2 is

$$\Pr(Y_i = 2 \mid X_i = 3) = \left( \frac{(1.2046383)(0.204683)}{2} \right) \left( \frac{4^2}{52.204683} \right) = \boxed{0.056760}$$

[10/5/2020] On page 187, in the solution to exercise 16.5, replace the last 4 lines with

$$\begin{aligned} \widehat{\text{VHM}} &= \frac{(200 - 400)^2 + 2(500 - 400)^2}{2} - \frac{50,833.33}{12} = 25,763.89 \\ \hat{k} &= \frac{50,833.33}{25,763.89} = 1.9730 \\ \hat{Z} &= \frac{12}{12 + 1.9730} = 0.858796 \\ P_W &= 0.858796(200) + 0.141204(400) = \boxed{228.24} \end{aligned}$$

[10/5/2020] On page 224, replace the solution to exercise 19.3 with

This model has one random effect, the apple, with a random intercept.  $\mathbf{D} = (1.43)$ . There are 3 observations within a subject, and no correlation between these observations (at least none is stated in

the question), so  $\mathbf{R} = \begin{pmatrix} 0.87 & 0 & 0 \\ 0 & 0.87 & 0 \\ 0 & 0 & 0.87 \end{pmatrix}$ . Since there is only a random intercept, the  $\mathbf{Z}$  matrix is  $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$ .

Then

$$\mathbf{V} = \mathbf{ZDZ}^t = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} (1.43) (1 \ 1 \ 1) + \begin{pmatrix} 0.87 & 0 & 0 \\ 0 & 0.87 & 0 \\ 0 & 0 & 0.87 \end{pmatrix} = \begin{pmatrix} 2.30 & 1.43 & 1.43 \\ 1.43 & 2.30 & 1.43 \\ 1.43 & 1.43 & 2.30 \end{pmatrix} \quad (\text{C})$$

[10/5/2020] On page 410, one line above the tables, change  $e^{\text{fitted value}}/(1 - e^{\text{fitted value}})$  to  $e^{\text{fitted value}}/(1 + e^{\text{fitted value}})$ .

[9/25/2020] On page 12, in the solution to exercise 1.1, change the last line to

$$= \Phi(0.13) - \Phi(-0.13) = 0.5517 - (1 - 0.4483) = \boxed{0.1034}$$

[9/24/2020] On page 294, on the last line of the solution to exercise 26.14, change  $0.8774883(3^{0.4884623}) = \boxed{1.500711}$  to  $0.8774883(6^{0.4884623}) = \boxed{2.105421}$ .

[9/21/2020] On page 4, replace the last sentence of the page with

So  $a = 1.645\sqrt{\text{variance}} = 1.645\sqrt{40,000} = 329$ , and this is  $329/5000 = \boxed{6.58\%}$  of the mean.

[9/21/2020] On page 318, on the third line, replace  $10\sqrt{\pi}$  with  $10\sqrt{2\pi}$  in two places.

[9/15/2020] On page 97, replace the solution to exercise 10.1 with

We add the number of periods to  $a$  and the total claims to  $b$ , obtaining  $a_* = 9 + 8 = 17$ ,  $b_* = 1 + 2 = 3$ , and the posterior mean of  $\theta$  is  $17/(17 + 3) = \boxed{0.85}$ .

[8/24/2020] On page 207, in the solution to exercise 17.3, delete  $+u_{2j} \times \text{AGENCYYEARS}_j$  from the second line. There cannot be random effects on level-2 variables.

[4/30/2012] On page 31, change the solution to exercise 3.9 to

$$\lambda_F = \left( \frac{\Phi^{-1}(0.99)}{0.05} \right)^2 = \left( \frac{2.326}{0.05} \right)^2 = 2164.11$$

For severity, the credibility standard is expressed in terms of number of exposures, which is number of claims. We had 1384 claims.

$$e_X = 2164.11 \left( \frac{6,010}{55^2} \right) = 4,300$$

$$Z_X = \sqrt{\frac{1,384}{4,300}} = 0.567354$$

For pure premium, the credibility standard is expressed in terms of number of exposures, which is number of policies. We have 21,000 policies. We divide the usual formula for the credibility standard in terms of number of expected claims by 0.085 to express it in terms of number of policies

$$e_P = \frac{2164.11}{0.085} \left( 1 + \frac{6,010}{55^2} \right) = 76,044$$

$$Z_P = \sqrt{\frac{21,000}{76,044}} = 0.525506$$

The absolute difference between credibility factors is  $\boxed{0.0418}$ . (A)