Errata and Updates for ASM Exam MAS-I (First Edition Fourth Printing) Sorted by Page

[5/28/2019] On page 131, in exercise 12.12, on the second line, change $k - l^{\text{th}}$ to $k - 1^{\text{th}}$.

[6/3/2019] On page 133, in exercise 12.13, 3 lines from the end of the solution, change $t/15$ to $x/15$.

[9/8/2020] On page 205, in the solution to exercise 18.9, on the last line, change 0.0018 to 0.018.

[5/28/2019] On page 228, on the last line of the solution to Example 21G, change the left side of the equation to

$$200(\ddot{a}_{\overline{10}|} + {}_{10}E_{60}\,\ddot{a}_{70})$$

[5/28/2019] On pages 231–245, there are several questions with the phrase "The of", with a big space between the two words. In that space, add the words "actuarial present value". This error occurs in exercises 21.4, 21.7, 21.8, 21.18, 21.24, and in the solution to exercise 21.27 and twice in the solution to exercise 21.28.

[5/28/2019] On page 251, in exercise 22.2, on the second line, put parentheses around "mod 7".

[5/28/2019] On page 251, in exercise 22.3, on the third line, delete the pair of parentheses between mod and 8.

[7/14/2019] On page 280, in exercise 24.12, on the last line, delete one of the "the"s.

[7/14/2019] On page 284, replace the solution to exercise 24.12 with

Using the method in Ross, we generate two exponential random numbers with mean 1, $Y_1 = -\ln 0.25 = 1.386294$ and $Y_2 = -\ln 0.74 = 0.301105$. Then we accept if $Y_2 > (Y_1 - 1)^2/2$, or

$$0.301105 > (1.386294 - 1)^2/2 = 0.07461$$

which is true. The generated normal number is positive since $0.34 < 0.5$. The standard normal random number is 1.386294, and the normal random number is $2 + 5(1.386294) = \boxed{\mathbf{8.93147}}$.

[9/4/2019] On page 363, Section 28.1, the smoothing method discussed is used if all observations are unique. If some observations are tied, an adjustment is made. Add the following after Quiz 28-1:

If there are ties among observations, then the highest quantile is assigned to the tied observation. For example, if the observations are $\{10, 22, 34, 34, 46\}$, then 34 is the 2/3 quantile but not the 1/2 quantile. Interpolation is then performed as above.

Example You are given the following losses:

$$10, \quad 22, \quad 34, \quad 34, \quad 46$$

Determine the smoothed empirical estimate of the 40th percentile and of the median.

Solution: For the 40th percentile, $0.4(5+1) = 2.4$, and we don't use the third observation since it is tied to the fourth. We interpolate between the second and fourth observations. We divided by 2, since $4 - 2 = 2$.

$$\hat{\pi}_{0.4} = \frac{(2.4-2)(34) + (4-2.4)(22)}{2} = \boxed{\mathbf{24.4}}$$

For the median, $0.5(5+1) = 3$, and

$$\hat{\pi}_{0.5} = \frac{(3-2)(34) + (4-3)(22)}{2} = \boxed{\mathbf{28}}$$

In this method, somewhat annoyingly, the median of a sample of odd size is not necessarily the middle element. □

[9/5/2019] On page 371, change exercise 28.18 to

From a sample of lives diagnosed with terminal cancer, you are given:

(i) The 25th percentile was 6.
(ii) The 75th percentile was 9.
(iii) The underlying distribution was Weibull.

Calculate $\hat{\tau}$ using percentile matching at the 25th and 75th percentiles.

[5/28/2019] On page 390, on the second line of the first paragraph of Subsection 29.1.3, change "observations" to "observation".

[5/28/2019] On page 411, in the solution to exercise 29.30, on the fourth line, the right parenthesis in the denominator should be before the exponent $\alpha + 1$.

[5/28/2019] On page 413, in item 6 in Section 30.1 on the second line, delete "parameters".

[5/28/2019] On page 495, on the second to third lines of the first paragraph, change "the next lesson" to "Lesson 37". On the last line of the page, change "the next lesson" to "Lesson 38".

[9/28/2019] On page 609, in the solution to exercise 44.8, on the last line, delete σ^2.

[3/3/2020] On page 650, in exercise 46.5, on the eighth line, change "volumne" to "volume".

[10/1/2019] On page 659, in the solution to exercise 46.20, the final answer should be $\boxed{\begin{pmatrix} \mathbf{-1.2306} \\ \mathbf{0.4542} \end{pmatrix}}$.

[3/3/2020] On page 690, in the solution to exercise 48.8, on the last line, put a minus sign before 15: $-\dfrac{(-15)(2000)}{(1500)(18)}$.

[3/3/2020] On page 698, on the third line of the page, add a "T" superscript to the third $\mathbf{X}$: $(\mathbf{X}^{\mathbf{T}}\mathbf{X})^{-1}\mathbf{X}^{\mathbf{T}}\mathbf{y}$. Three lines above Section 49.2, replace the displayed line with

$$\sum (y_i - \bar{y})^2 - b_2^2 \sum (x_i - \bar{x})^2 = 282.8133 - 1.1771^2(158.8333) = 61.71$$

Replace the last line before Section 49.2 with

$$F_{1,3} = \frac{(61.71 - 10.42)/1}{(10.42/3)} = \boxed{\mathbf{14.77}}$$

[9/22/2019] On page 703, in exercise 59.15, on the second line, change $\beta_3 x_{i2} x_{i3}$ to $\beta_4 x_{i2} x_{i3}$.

[7/16/2019] On page 714, on the second line of the solution to Quiz 49-2, add a right parenthesis to the first denominator after $(21 - 2 - 1$.

[9/27/2020] On page 761, in the solution to exercise 52.23, on the third line, change 200 to 400.

[9/27/2020] On page 776, in the solution to exercise 53.11, on the third line, the last expression in the parentheses is incorrect. The line should read

$$C = 2 \sum y_i \ln \left(\frac{\hat{y}_i}{\bar{y}} \right) = 2 \left(\sum y_i \ln \hat{y}_i - (\ln \bar{y}) \sum y_i \right)$$

[10/31/2019] On page 802, on the first displayed line, change the upper bound on the summation sign to p.

[9/3/2019] On page 825, in the solution to exercise 58.2, on the third line, change 103 to 102 and change 116.7917 to 116.625. Change the last line to "The monthly additive effect is $116 - 116.625 = \boxed{\mathbf{-0.625}}$.

[9/4/2019] On page 849, replace the solution to exercise 61.10 with

Apply $y_t = 3 + 0.301y_{t-1} - 0.205y_{t-2} + 0.088y_{t-3}$ twice.

$$\hat{x}_{2017|2016} = 3 + 0.301(3.41) - 0.205(3.52) + 0.088(2.61) = 3.53449$$
$$\hat{x}_{2018|2016} = 3 + 0.301(3.53449) - 0.205(3.41) + 0.088(3.52) = \boxed{\mathbf{3.67459}}$$

[9/21/2020] On page 855, in exercise 62.7, in the first bullet, change "residual" to "time series".

[10/15/2019] On page 858, in the solution to exercise 62.8, change the last line to

$$23.04\left(1 + \frac{1}{11} + \frac{6^2}{1105}\right) = \boxed{\mathbf{32.6749}}$$

[3/6/2020] On page 866, in exercise 63.12, the symbol w_t is used in two different ways. Change the question to

A monthly time series x_t has seasonal differences $z_t = x_t - x_{t-12}$ that satisfy $z_t = w_t - 0.5w_{t-12}$, where the w_t are normally distributed independent random variables with mean 0 and variance 1.

Determine the lag 1 autocorrelation coefficient for z_t.

[3/6/2020] On page 870, in the solution to exercise 63.12, change $\beta_{12} = 0.5$ to $\beta_{12} = -0.5$.

[8/13/2019] On page 1048, in the solution to question 37, on the first line, change the empty brakets "[]" to "[Section 21.1]".

[7/14/2019] On page 1050, in the solution to question 37, on the first line, change the empty brackets "[]" to "[Section 21.3]".

[7/16/2019] On page 1052, between the last two lines of the page, add

15. **[Section 21.1]** The joint probabilities of survival are:

$$p_{0:0} = (1 - 0.03)^2 = 0.9409$$
$${}_2p_{0:0} = 0.9409(1 - 0.09)^2 = 0.7792$$
$${}_3p_{0:0} = 0.7792(1 - 0.14)^2 = 0.5763$$

so the probabilities of failure in each year are the differences:

$$q_{0:0} = 1 - 0.9409 = 0.0591$$
$${}_{1|}q_{0:0} = 0.9409 - 0.7792 = 0.1617$$
$${}_{2|}q_{0:0} = 0.7792 - 0.5763 = 0.2029$$

and the answer is

$$100\left(\frac{0.0591}{1.05} + \frac{0.1617}{1.05^2} + \frac{0.2029}{1.05^3}\right) = \boxed{\mathbf{37.8}} \qquad \mathbf{(C)}$$

[7/16/2019] On page 1053, between the line starting **21–23** and the line starting **25–28**, add

24. **[Section 4.1]** There is no discount in the first period and a 0.3 probability of being preferred in the second period. To calculate the probability of being preferred in the third period, we sum up the products:

$$(0.3)(0.6) + (0.6)(0.3) + (0.1)(0.1) = 0.37$$

We discount the probabilities.

$$40\left(\frac{0.3}{1.04} + \frac{0.37}{(1.04)(1.05)}\right) = \boxed{\mathbf{25.09}} \qquad \mathbf{(B)}$$

Add the following before the last line on page 1053:

35. **[Lesson 16]** The compound mean is $100r\beta = 100(1.1)(1) = 110$. The compound variance is

$$\begin{aligned}\operatorname{Var}(S) &= \lambda\bigl(\mathbf{E}[X]^2 + \operatorname{Var}(X)\bigr)\\ &= 100\bigl((r\beta)^2 + r\beta(1+\beta)\bigr)\\ &= 100\bigl(1.1^2 + 1.1(1)(2)\bigr) = 341\end{aligned}$$

The 99$^{\text{th}}$ percentile of a normal distribution is 2.326. So we need $110 + 2.326\sqrt{341} = 152.95$, or $\boxed{\mathbf{153}}$ sets. Strictly speaking, a continuity correction should be made, so that the answer would be $152.95 + 0.5 = 153.45$, which would then have to be rounded up to 154, but the answer choice ranges did not require this refinement. **(E)**

After the end of page 1053, add

37. **[Lesson 16]** Combined teller services are 1 per 10 minutes plus 1 per 15 minutes, or $\frac{1}{10} + \frac{1}{15} = \frac{1}{6}$ per minute. With 360 minutes from 9 am to 3 pm, 60 services are completed. Of these, one third or 20 are deposits.

The average deposit handled by tellers per deposit is the average of the deposit if it is less than 7500, 0 otherwise, or

$$\int_0^{7500} xf(x)\mathrm{d}x = \mathbf{E}[X \wedge 7500] - 7500\bigl(1 - F(7500)\bigr)$$

Using the tables of distributions, this is

$$\frac{\theta}{\alpha-1}\left(1 - \left(\frac{\theta}{\theta+7500}\right)^{\alpha-1}\right) - 7500\left(\frac{\theta}{\theta+7500}\right)^{\alpha} = 2500(1-0.4^2) - 7500(0.4^3) = 1620$$

The expected total deposits is $(20)(1620) = \boxed{\mathbf{32{,}400}}$. **(B)**

38. **[Lesson 16]** The charge per call X is \$3, plus \$1 if it lasts longer than 1 minute, \$1 if it lasts longer than 2 minutes, etc., or with T being the call time,

$$\begin{aligned}\mathbf{E}[X] &= 3 + \sum_{t=1}^{\infty} \Pr(T > t)\\ &= 3 + \sum_{t=1}^{\infty} e^{-t/4}\\ &= 3 + \frac{e^{-1/4}}{1 - e^{-1/4}}\\ &= 3 + \frac{0.778801}{1 - 0.778801} = 6.5208\end{aligned}$$

Multiplying by the number of calls (100), the answer is $\boxed{\mathbf{\$652.08}}$. **(D)**

39–40. *Questions 39–40 are not on the current Exam MAS-I syllabus*

[7/16/2019] On page 1056, between the lines starting **29=-31** and **33–37** add

32. **[Lesson 13]** In this Poisson process, a subprocess of losses greater than 100,000 is also a Poisson process with parameter $0.3\bigl(1-F(100{,}000)\bigr)=0.3(0.4)=0.12$. The probability it is at least 1 is $1-e^{-0.12}=\boxed{\mathbf{0.11308}}$. **(B)**

Between the lines starting **33–37** and **39–40** add

38. **[Section 4.1]** After one year, the state vector is the second row of the matrix, $\begin{pmatrix}0.3 & 0.5 & 0.2\end{pmatrix}$. After two years, the state vector is

$$\begin{pmatrix}0.3 & 0.5 & 0.2\end{pmatrix}\begin{pmatrix}0.60 & 0.30 & 0.10\\ 0.30 & 0.50 & 0.20\\ 0.00 & 0.40 & 0.60\end{pmatrix}=\begin{pmatrix}0.33 & 0.42 & 0.25\end{pmatrix}$$

The expected premium is 500 in the first year; $0.3(450)+0.5(500)+0.2(575)=500$ in the second year; and $0.33(450)+0.42(500)+0.25(575)=502.25$ in the third year. The expected present value is

$$500+\frac{500}{1.05}+\frac{502.25}{1.05^2}=\boxed{\mathbf{1431.75}}\qquad\textbf{(B)}$$

[7/16/2019] On page 1057, between the lines starting **3–4** and **6–9** add

5. **[Section 20.1]**

$$1000\,{}_{2|3}q_{60}=\frac{1000(l_{62}-l_{65})}{l_{60}}=\frac{1000(7{,}954{,}179-7{,}533{,}964)}{8{,}188{,}074}=\boxed{\mathbf{51.32}}\qquad\textbf{(C)}$$

Between the lines starting **6–9** and **12–17** add

10. **[Lesson 29]** The likelihood function is

$$L(\theta)=\begin{cases}e^{-\sum Y_i+n\theta} & Y_i>\theta\text{ for all }Y_i\\ 0 & \text{otherwise}\end{cases}$$

The function grows with increasing θ. To maximize it, make θ as high as possible without being higher than any Y_i; in other words, make it the minimum of the Y_i. **(D)**

11. **[Lesson 29]** Let $A=\prod_{i-1}^{5}x_i=(0.92)(0.79)(0.90)(0.65)(0.86)=0.365653$. Maximizing the likelihood function,

$$\begin{aligned}L(\theta)&=(\theta+1)^5A^\theta\\ l(\theta)&=5\ln(\theta+1)+\theta\ln A\\ \frac{\mathrm{d}l}{\mathrm{d}\theta}&=\frac{5}{\theta+1}+\ln A=0\\ \theta&=\frac{5}{-\ln A}-1=\frac{5}{1.00607}-1=\boxed{\mathbf{3.9698}}\qquad\textbf{(E)}\end{aligned}$$

[8/13/2019] On page 1058, in the solution to question 31, on the first line, replace "[]" with "[**Section 48.2**]".

[7/16/2019] On page 1060, between the lines starting **12–35** and **38–39** add

36. **[Section 4.1]** Let x be the desired probability. The transition probability matrix is (making Preferred the first state)

$$\begin{pmatrix} 0.8 & 0.2 \\ x & 1-x \end{pmatrix}$$

We are given for a driver initially Standard

$$\begin{pmatrix} x & 1-x \end{pmatrix}\begin{pmatrix} 0.2 \\ 1-x \end{pmatrix} = 0.44$$

We solve for x.

$$\begin{aligned} 0.2x + (1-x)^2 &= 0.44 \\ 0.2x + 1 - 2x + x^2 - 0.44 &= 0 \\ x^2 - 1.8x + 0.56 &= 0 \\ (x-0.4)(x-1.4) &= 0 \\ x &= \boxed{\mathbf{0.4}}, 1.4 \qquad \textbf{(B)} \end{aligned}$$

37. **[Section 21.1]** We must back out v.

$$\begin{aligned} {}_2p_{50} &= 1 - q_{50} - {}_{1|}q_{50} = 1 - 0.04 - 0.08 = 0.88 \\ {}_2E_{50} &= 0.88v^2 \\ v &= \sqrt{\frac{0.84}{0.88}} = 0.9770 \end{aligned}$$

The term insurance's EPV is

$$A^{\;1}_{50:\overline{2}|} = 0.04(0.9770) + 0.08(0.9770^2) = \boxed{\mathbf{0.1154}} \qquad \textbf{(E)}$$

At the end of the page add

40. **[Lesson 4]** In the first year, payment only occurs for transition for State 1 to State 2, probability 0.4, expected payment (0.4)(70) = 28.

    In the second year, there's a 0.6 chance of being in State 1 at the beginning of the year, and then a (0.6)(0.4) = 0.24 chance of transition to State 2, expected payment (0.24)(70) = 16.8. There's a 0.4 chance of being in State 2 at the beginning of the second year, and then the expected payments occur upon transition to State 1 or State 3, expected value being (0.4)(0.1)(30) + (0.4)(0.2)(100) = 9.2. Total expected payment in step 2 is 16.8 + 9.2 = 26. EPV of both payments is $\frac{28}{1.1} + \frac{26}{1.1^2} = \boxed{\mathbf{46.94}}$. **(C)**

[7/16/2019] On page 1073, on the line above the line starting with **16–17**, add

15. **[Section 21.2]** This annuity is a 10-year certain annuity-immediate plus a 10-year deferred whole life annuity-immediate. The present value of the certain annuity is

$$a_{\overline{10}|} = \frac{1 - (1/1.06^{10})}{0.06} = 7.3601$$

The deferred annuity-immediate's APV can be evaluated as

$${}_{10}E_{66}\, a_{76} = {}_{10}E_{66}(\ddot{a}_{76} - 1)$$

Using the illustrative Life Table, the sum of the two annuities is

$$7.3601 + (0.38753)(6.9493 - 1) = 9.6656$$

Therefore, the benefit is $250{,}000/9.6656 = \boxed{\mathbf{25{,}865}}$. **(D)**

[10/22/2019] On page 1075, the solutions labeled as solutions to questions 8–10 are actually solutions to question 10–12. The solutions to questions 8 and 9 are:

8. **[Section 4.1]** The state vector at the end of week 2 is $\begin{pmatrix}0.2 & 0.8\end{pmatrix}$. Then the state vector at the end of week 3 is
$$\begin{pmatrix}0.2 & 0.8\end{pmatrix}\begin{pmatrix}0.9 & 0.1\\0.2 & 0.8\end{pmatrix} = \begin{pmatrix}0.34 & 0.66\end{pmatrix}$$
The probability of transition from state 1 to state 2 in the fourth week is $(0.34)(0.1) = \boxed{\mathbf{0.034}}$. **(B)**

9. **[Section 4.1]** The state vector at the end of one period is $\begin{pmatrix}0.8 & 0.2\end{pmatrix}$. At the end of two periods, it is
$$\begin{pmatrix}0.8 & 0.2\end{pmatrix}\begin{pmatrix}0.8 & 0.2\\1-p & p\end{pmatrix} = \begin{pmatrix}0.84 - 0.2p & 0.16 + 0.2p\end{pmatrix}$$
At the end of three periods, the second entry in the state vector is 0.312, which is equal to $0.2(0.84 - 0.2p) + p(0.16 + 0.2p)$, or
$$\begin{aligned}0.2(0.84 - 0.2p) + 0.16p + 0.2p^2 &= 0.312\\ 0.168 + 0.12p + 0.2p^2 &= 0.312\\ 0.2p^2 + 0.12p - 0.144 &= 0\\ p = \frac{-0.12 + \sqrt{0.1296}}{0.4} &= \boxed{\mathbf{0.6}} \qquad \textbf{(E)}\end{aligned}$$

After the solution to question 17, add

18. **[Lesson 29]** For the first two observed losses x_i, the likelihood is the exponential probability density function $e^{-x_i/\theta}/\theta$. For the observed loss of 5000, the likelihood is the probability of a loss of at least 5000, or $s(5000) = e^{-5000/\theta}$. Multiplying the three likelihoods together:
$$\begin{aligned}L(\theta) &= \frac{1}{\theta^2}e^{-(1000+2500+5000)/\theta}\\ l(\theta) &= -2\ln\theta - \frac{8500}{\theta}\\ \frac{\mathrm{d}l}{\mathrm{d}\theta} &= -\frac{2}{\theta} + \frac{8500}{\theta^2} = 0\\ \theta &= \frac{8500}{2} = \boxed{\mathbf{4250}} \qquad \textbf{(E)}\end{aligned}$$

19. **[Lesson 29]** Since $F(x) = x^{k+1}$, the likelihood of one observation of 0.75 and one less than 0.75 is
$$\begin{aligned}L(k) &= F(0.75)f(0.75) = 0.75^{k+1}(k+1)0.75^k = (k+1)0.75^{2k+1}\\ l(k) &= \ln(k+1) + (2k+1)\ln 0.75\end{aligned}$$

$$\frac{\mathrm{d}l}{\mathrm{d}k} = \frac{1}{k+1} + 2\ln 0.75 = 0$$
$$\hat{k} = -\frac{1}{2\ln 0.75} - 1 = \boxed{\mathbf{0.73803}} \qquad \textbf{(D)}$$

The solutions numbered 18–21 should be renumbered 20–23.

[7/16/2019] On page 1077, after the line starting with **12-15**, add

16. [**Section 4.1**] We're interested in the next 3 time periods, starting immediately. The state vectors are $\begin{pmatrix}1 & 0\end{pmatrix}$ at the beginning of period 1, $\begin{pmatrix}0.7 & 0.3\end{pmatrix}$ at the beginning of period 2, and

$$\begin{pmatrix}0.7 & 0.3\end{pmatrix}\begin{pmatrix}0.7 & 0.3\\ 0.8 & 0.2\end{pmatrix} = \begin{pmatrix}0.73 & 0.27\end{pmatrix}$$

at the beginning of period 3. The cash flows paid are 0.3 times the probability of being in state 1, or

$$10\left(\frac{0.3}{1.05} + \frac{0.7(0.3)}{1.05^2} + \frac{0.73(0.3)}{1.05^3}\right) = 6.653709$$

The premiums are P times $0.3/1.05+0.27/1.05^2 = 0.530612$. Therefore, $P = 6.653709/0.530612 = \boxed{\mathbf{12.54}}$. **(D)**

The solutions numbered 16–23 should be renumbered 17–24.

[7/16/2019] On page 1082, after the solution to question 8, add

9. [**Lesson 11**] The parameter for the Poisson distribution is the integral of $\lambda(t)$ from 0 to ∞, or

$$\int_0^\infty \frac{100}{(1+t)^3}\,\mathrm{d}t = -\left.\frac{50}{(1+t)^2}\right|_0^\infty = \boxed{\mathbf{50}} \qquad \textbf{(B)}$$

10. [**Lesson 13**] The probability of a claim exceeding 1 million is $e^{-1{,}000{,}000/160{,}000} = 0.001930$. Thus the process of catastrophes is Poisson with parameter $200(0.001930) = 0.386091$, so interevent time is exponential with mean $1/0.386091 = 2.59$. The median of an exponential with mean θ is

$$e^{-x/\theta} = 0.5$$
$$\frac{x}{\theta} = -\ln 0.5 = \ln 2$$
$$x = \theta\ln 2$$

and $2.59\ln 2 = \boxed{\mathbf{1.7953}}$. **(B)**

11. [**Lesson 16**] Mean payments for one year are $120(500) = 60000$. The variance is

$$\mathrm{Var}(S) = \lambda t\,\mathbf{E}[X^2] = 120(2\cdot 500^2) = 6\times 10^7$$

The probability we seek is

$$1 - \Phi\left(\frac{70{,}000 - 60{,}000}{\sqrt{6\times 10^7}}\right) = 1 - \Phi(1.291) = \boxed{\mathbf{0.0984}} \qquad \textbf{(D)}$$

[7/16/2019] On page 1084, at the beginning of the solution to question 12, replace "[]" with "[Section 21.2]".

[7/21/2019] On page 1088, at the beginning of the solution to question 14, replace "[]" with "[Section 21.3]"

[7/16/2019] On page 1088, replace the line beginning with **15.** with

15–16. *Questions 15–16 are not on the current Exam MAS-I syllabus*

Renumber the solutions to questions 16–21 to 17–22.

On page 1089, after the last line on the page, add

25. [**Lesson 46**] You can do the regression on a statistics calculator, but we'll carry out the steps.

$$\begin{aligned}
\bar{X} &= \frac{10+13+20+15+5}{5} = 12.6 \\
\frac{\sum X_i^2}{5} &= \frac{10^2+13^2+20^2+15^2+5^2}{5} = 183.8 \\
\hat{\sigma}_x^2 &= 183.8 - 12.6^2 = 25.04 \\
\bar{Y} &= \frac{22+20+6+18+10}{5} = 15.2 \\
\frac{\sum X_i Y_i}{5} &= \frac{(10)(22)+(13)(20)+(20)(6)+(15)(18)+(5)(10)}{5} = 184 \\
\widehat{\mathrm{Cov}}(X,Y) &= 184 - (12.6)(15.2) = -7.52 \\
\hat{\beta} &= \frac{-7.52}{25.04} = -0.30032 \\
\hat{\alpha} &= 15.2 - (-0.30032)(12.6) = 18.98403
\end{aligned}$$

At $X = 12$, the estimated value of Y is $18.98403 - 0.30032(12) = 15.38019$. So the residual is $18 - 15.38019 = \boxed{2.61981}$. **(C)**

[7/21/2019] On page 1090, on the second line of the page, in the url, change "`f13-3`" to "`fall13-3`".

[7/16/2019] On page 1104, add the following at the top of the page:

20. [**Section 48.3**] The fourth bullet is the error sum of squares. It follows that the standard error of the regression is

$$s^2 = \frac{\mathrm{SSE}}{n-2} = \frac{25}{4}$$

The third bullet provides the sum of the squared deviations of x_is from their means. By formula (48.6),

$$s_\beta^2 = \frac{s^2}{\sum(x_i - \bar{x})^2} = \frac{25/4}{50} = 0.125$$

The t coefficient for 4 degrees of freedom and 0.05 are in both tails is 2.776. The upper bound of the 95% confidence interval for β_1 is $4 + 2.776\sqrt{0.125} = \boxed{4.981}$. **(A)**

Renumber the solution to question 20 to 21.

[7/16/2019] On page 1126, delete the redundant line that is 7 lines from the bottom and begins with **28**.

[8/13/2019] On page 1182, change the reference for Spr 2007 Q31 from 46 to 48. Change the reference for Fall 2007 Q6 from NS to 27.

[7/21/2019] On pages 1183–1184, replace Tables C.3 and C.4 with the tables in the pages at the end of this errata listing.

Table C.3: Lessons corresponding to questions on released CAS 3L exams Spring 2008 — Fall 2013

	CAS 3L Exams											
Q	Spr 2008	Fall 2008	Spr 2009	Fall 2009	Spr 2010	Fall 2010	Spr 2011	Fall 2011	Spr 2012	Fall 2012	Spr 2013	Fall 2013
1	1	11	NS	20	20	NS	NS	NS	NS	NS	NS	NS
2	25	11	NS	NS	NS	20	NS	NS	NS	NS	NS	NS
3	29	16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
4	37	29	NS	NS	NS	NS	NS	NS	20	NS	NS	NS
5	33	25	NS	NS	NS	NS	20	NS	NS	NS	NS	NS
6	35	29	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
7	NS	40	4	NS	NS	NS	NS	NS	NS	NS	4	NS
8	NS	39	13	NS	NS	4	4	NS	4	4	4	4
9	46	37	13	21	NS	4	11	NS	11	13	11	11
10	11	NS	16	13	4	12	13	15	13	12	12	13
11	11	35	NS	13	4	11	16	12	16	16	16	16
12	16	NS	NS	NS	11	16	NS	NS	NS	21	NS	21
13	NS	20	NS	21	15	NS	NS	NS	NS	NS	21	NS
14	NS	NS	NS	NS	16	NS	NS	NS	NS	NS	21	NS
15	NS	NS	NS	NS	21	NS	NS	NS	NS	NS	NS	NS
16	NS	NS	4	4	NS	NS	4	4	NS	4	NS	4
17	NS	NS	27	27	NS	4	25	25	29	29	29	25
18	NS	NS	35	29	21	29	29	29	29	27	29	29
19	NS	4	29	29	4	29	27	29	29	25	25	29
20	4	21	33	38	25	27	37	33	35	29	33	NS
21	NS	NS	38	34	29	34	33	33	33	35	34	38
22	NS	NS	35	40	38	37	33	33	35	33	35	33
23	NS	NS	18	37	37	38	33	NS	40	37	NS	12
24	NS	NS	NS	NS	35	NS	33	NS	NS	NS	NS	NS
25	NS	4	46	38	NS	38	NS	46	46	NS	46	38

Table C.4: Lessons corresponding to questions on released CAS ST exams

Q	Spr 2014	Fall 2014	Spr 2015	Fal 2015	Spr 2016
1	13	15	13	11	14
2	15	13	12	11	12
3	16	16	16	16	16
4	29	29	25	25	29
5	25	31	31	29	25
6	29	25	29	31	32
7	29	32	29	29	29
8	NS	29	29	32	29
9	37	29	31	29	25
10	33	39	37	39	37
11	35	35	33	34	34
12	35	33	35	33	35
13	35	40	39	38	33
14	40	39	33	37	40
15	NS	33	35	39	39
16	NS	35	NS	35	NS
17	NS	NS	NS	NS	NS
18	NS	NS	NS	NS	NS
19	52	NS	NS	NS	NS
20	48	48	48	NS	48
21	52	52	49	48	49
22	NS	NS	48	52	49
23	NS	NS	NS	NS	NS
24	NS	NS	NS	NS	NS
25	NS	NS	NS	NS	NS

Table C.5: Lessons corresponding to questions on released CAS LC exams

Q	Spr 2014	Fall 2014	Spr 2015	Fall 2015	Spr 2016
1	NS	20	NS	NS	20
2	NS	NS	NS	20	20
3	NS	NS	NS	NS	NS
4	NS	NS	NS	NS	NS
5	NS	NS	NS	NS	NS
6	NS	NS	NS	NS	NS
7	NS	NS	NS	NS	NS
8	NS	NS	NS	NS	NS
9	NS	4	4	4	4
10	4	4	4	4	4
11	4	NS	NS	NS	NS
12	21	NS	NS	NS	21
13	NS	NS	NS	21	NS
14	NS	NS	NS	4	21
15	4	4	4	4	4