

**Errata**

Modeling Longitudinal Data  
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P = Page  
 Pr = Problem  
 L = Line  
 D = Display  
 T = Table  
 E = Equation  
 F = Figure

Negative line numbers indicate lines from the bottom. Captions on figures or tables are not counted in the line count. Section, subsection, subsection titles and displayed equations are included in the line counts. A display is any formula or equation centered on its own line.

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**P xii L 1-2** Delete “Plus Independent Error” in the title of section 8.5.1.

**P xxii, L 14** Insert after the period: “I am indebted to and grateful to Vicente Nuñez-Anton for his careful reading of the text and for informing me of the mistakes, errors, typos and inaccuracies that he found. He did the lion’s share of the work of writing the errata sheet for the first printing.”

**P 11, T 1.1** Third column, bottom two entries, insert two “,” commas, one after each “Yes”.

**P 13, L 14** Replace “affect” with “effect”.

**P 29 D 2** Delete 2nd  $j$  subscript on  $s_{jj}$  and define  $s_j = s_{jj}^{1/2}$ . It should read

$$s_j = s_{jj}^{1/2} = \left[ \frac{1}{n-1} \sum_{i=1}^n (Y_{ij} - \bar{Y}_{.j})^2 \right]^{1/2}$$

**P 31 L 8** Replace “The box plot is less crowded than 2.1.” with “The box plots in figure 2.2 are less crowded than the scatterplot in figure 2.1.”

**P 33 L -19** Insert “as in figure” before the “2.1”.

**P 38 L -10** Replace “ $(t_{ij+1}, Y_{ij+1})$ ” by “ $(t_{i(j+1)}, Y_{i(j+1)})$ ”.

**P 43, L -21** Insert “data like in 2.5(c)” with “data like that presented in Figure 2.5(c).”

**P 44 L -8** Replace “Figure 2.8 illustrates.” with “Figure 2.8 illustrates this.”

**P 47 L 16** Replace “24” by “21”.

**P 53 L -3 -2** Replace “on a plot like 2.15.” with “on a plot like the one in Figure 2.15.”

**P 56, 57** Figure captions,  $y$  axes should say “Residual Weight (mg)”.

**P 57 L -1** Last word should be “need” not “needs”.

**P 58 L 3** Replace “ $s_j^2$ ” with “ $s_{jj}$ ”.

**P 59 L -10** Delete “abruptly”. Change .86 to .80 and change .96 to .92.

**P 59 L -8** Change .37 to .36.

**P 63 L -2** Change “show” to “shows.”

**P 64 L -9** Change “figure 2.21a” to “figure 2.21(a)”.

**P 65 L -10** and L -13 and L -15. Include a hat  $\hat{\rho}_{jk}$  on  $\rho_{jk}$  to make  $\hat{\rho}_{jk}$ .

**P 65 Section 2.5.3** This definition of a correlogram is appropriate for longitudinal data. The correlogram originated from time series data which usually has a single long sequence of temporally ordered repeated measures. To calculate a correlogram for time series data, assume that the time series is *stationary*, meaning that the correlation between observations at time points  $t_1$  and  $t_2$  depends only on the time difference  $t_2 - t_1$  and not on the absolute time  $t_1$  or  $t_2$ . In contrast, for equally spaced longitudinal data, we only assume equal correlation between observations on different subjects  $i$  and  $i'$  that have  $t_{i1} = t_{i'1}$  and  $t_{i2} = t_{i'2}$ . For time series data there is one correlation estimate plotted in the correlogram for observations that are  $K$  time units apart, for  $k = 1$  up to potentially,  $k = n - 2$ . A comment from Vicente Nuñez-Anton: According to Diggle (1990) [Diggle, P.J. (1990). *Time Series. A Biostatistical Introduction*. Oxford: Oxford University Press], if we define the  $k$ -th sample autocovariance coefficient as

$$g_k = \sum_{t=k+1}^n (y_t - \bar{y})(y_{t-k} - \bar{y})/n,$$

then the  $k$ -th sample autocorrelation coefficient is

$$r_k = g_k/g_0.$$

A plot of  $r_k$  against  $k$  is called the correlogram of the data  $\{y_t\}$ .

**P 67 L 4, 5, 10** Delete the superscript 2:  $s_{jj}^2$  should be  $s_{jj}$  and then, on line 5,  $s_{jj}$  now needs a square root and should be  $s_{jj}^{1/2}$ . And on line 10,  $\pm 2s_{jj}^{1/2}$ .

**P 75 Pr 8 L 6, 8** Line 6 of problem 8 on page 75. That should read “In your calculations from figure 2.5(a) the means vary quite a lot, even . . .”, and should not refer to figure 2.4. On line 8, delete “in this plot”.

**P 78 Pr 21 L -1** . Delete the first “b” in the reference to problem 21b(b).

**P 79 P 23 L 1** Replace the first sentence with “Plot the Weight Loss data as in Figure 2.14, one subject’s profile to a plot.”

**P 81 Pr 26** Insert “(table 2.10)” after “Dental data set”.

**P 88 L -11** Replace “33.8” by “33.7”. Entries on pages 88 and 89 are computed with several additional digits of accuracy, before being rounded. For example, in table 3.2,  $2^{5.08} = 33.82458$ , but the correct  $\log_2$  seconds was 5.07617, not 5.08, which is what it rounds to, and  $2^{5.07617} = 33.73491$  which was rounded to 33.7. This happens in a few other places as well.

**P 102 D 4** Both  $ds$  should have \* and both lower case  $ys$  should be capitalized.

$$\bar{d}^* = \frac{1}{N_g} \sum d_i^* = \frac{1}{N_g} \sum_i Y_{i4} - \frac{1}{N_g} \sum_i \bar{Y}_{i,\text{baseline}}$$

**P 106 D 3** Subscript in sum should be  $j$  not  $i$ .

$$\bar{t}_i = n_i^{-1} \sum_{j=1}^{n_i} t_{ij}.$$

**P 110 L 5, 8** of caption. Replace (e) by (f) two times. L 6 insert “improves” at end of sentence.

**P 115 L 1** of caption T 4.1. Replace “problem” by “problems”.

**P 116 L 15** Replace “unequivical” by “unequivocal.”

**P 118 D5.2** Replace “==” by “=”.

**P 120 L -1** Change  $s_{jj}^{1/2}/n$  to  $(s_{jj}/n)^{1/2}$ .

**P 121 L 4** Change “intervals” to “interval”.

**P 121 L 5** (Displayed equation). Divide both sides of the confidence interval formula by  $n^{1/2}$  to get a correct formula.

**P 121 L 8, 10** Twice, replace the  $n - l$  degrees of freedom in the  $t$  distribution by  $n - 1$ . The  $ell$  is replaced by a numeral one.

**P 131, L -7**  $-1.111/0.095 \simeq -12$  and not 12.

**P 134 L -15** . Replace the comma by a period right after “data” and before “In mathematical”

**P 139 L -1** Change “184 to 196 pounds” to “188 to 202 pounds”.

**P 150 L -8** “the probability of model 1 is less 0.0025” should say “the probability of model 2 is less than 0.0025”

**P 153 L 17, 18** The  $K$  variables and  $2^K$  models should say  $K - 1$  variables and  $2^{K-1}$  for consistency.

**P 154 D 1** In the sampling density of the normal, the exponent needs a minus “-” sign.

**P 155 D 1** Line 3 also needs a minus sign in the exponent.

**P 154 L -14** Delete “-” after *likelihood*.

**P 157 L -14** Replace “ $\sigma_{11}$ ” by “ $\hat{\sigma}_{11}$ ”.

**P 158 L-7,-3** Replace “ $\theta^{l+1}$ ” by “ $\theta^{(l+1)}$ ”, replace “ $\theta^l$ ” by “ $\theta^{(l)}$ ” in two places.

**P 161 L 11** Replace “ $\theta^l$ ” by “ $\theta^{(l)}$ ”.

**P 164 D 1** Switch the conditions around. Also, the three “Y”s should be “W”s

$$W^{(\lambda)} = \begin{cases} W^\lambda & \lambda \neq 0 \\ \log W & \lambda = 0 \end{cases}.$$

**P 164 L-8,-9** Replace “Y” with “W” three times.

**P 165 L -14** Replace “SEpred( $x' \hat{\alpha}$ )” by “SEpred( $x' \hat{\alpha}$ )”.

**P 165 L -11** Replace “Interval (6.6.1)” with “This interval”.

**P 166 L 13** Change “on” to “to”.

**P 166 L 15** Switch the “W”s and “Y”s. Change “ $h(W) = Y$ ” to “ $h(Y) = W$ ” and change “ $W = g(Y)$ ” to “ $Y = g(W)$ ”.

**P 166 D 3,6** Twice replace “ $\lambda$ ” with “ $1/\lambda$ ”. Giving

$$\frac{d(c\mu^{1/\lambda})}{d\mu} = c1/\lambda\mu^{\lambda-1}$$

And replace “ $\lambda$ ” with “ $1/\lambda$ ” three times for display 6 giving

$$\text{SE}(c\hat{\mu}^{1/\lambda}) = c\text{SE}(\hat{\mu})\lambda^{-1}\hat{\mu}^{1/\lambda-1}$$

**P 168 T 6.2** On line 5 of the caption delete the “1” in front of  $W_{ij}$ .

**P 170 L -9** Replace the “3” by “2” giving  $C_1 < 2C_2$ .

**P 172 D 2** Delete “ $-\alpha_1$ ” giving

$$d_i \equiv Y_{i2} - Y_{i1} = \alpha_2 + \epsilon_{i2} - \epsilon_{i1}$$

**P 180, L 4** of the caption. Replace “ $\alpha = (2, 1.1, 2.1)$ ” by “ $\alpha = (2, 1.1, 2.3)$ ”.

- P 181, L 20** Replace “Now let the rows of  $X_i$  be  $x_{ij} = (G_i, 1 - G_i)'$ .” by “Now let the rows of  $X_i$  be  $x'_{ij}$ , where  $x_{ij} = (G_i, 1 - G_i)'$ .”
- P 181, L -12** Insert “has a coefficient that” between “of which” and “is the population”
- P 184, L 9–11** Replace “17.54” with “17.58” twice and replace “0.0063” by “0.0061” three times. Change “17.95” to “17.98”, “18.14” to “18.13” and “.20” to “.19”.
- P 184, L 13** formula should be “ $100 \approx .63/.0061$ ”.
- P 188 T 7.4** Numbers do not quite add up due to rounding.
- P 190 T 7.5** Again, numbers do not quite add up due to rounding.
- P 196 L 3** of caption of figure 7.4, delete the letter “c”.
- P 198 L -17** After line -18, before line -17, insert the sentence “Figure 7.5(a) plots the estimated population average responses against trial number for six subjects from all combinations of coping styles and interventions from this model.”
- P 198-199** Last line of 198 to first line of 199. Delete “in the absence of the covariance”.
- P 215** Two lines below fourth displayed equation. Change “versus time” to “instead of months”.
- P 219 L -15** Replace “Figure 7.10 illustrates.” with “Figure 7.10 illustrates this.”
- P 226 L 12** Delete the minus sign – in  $-.062 \times 18 \approx 1.1$ .
- P 232 L 2,9** Replace “backwards” by backward.”
- P 234 L 13** In line 1 of Problem 10, replace “ $E[Y_{ij}|\alpha, t_{ij} = ]$ ” by “ $E[Y_{ij}|\alpha, t_{ij}] = .$ ”
- P 234 L -4** Replace “7.4” with “Table 7.5”.
- P 235 Pr 13** Because the heterogeneous antedependence model won’t be introduced till later, replace “heterogeneous antedependence model” with “autoregressive” model.
- P 236 Pr 19** In line 4 of Problem 19, replace “what is the” by “what are the”.
- P 236 L -5** Replace “ie time” by “i.e., time.”
- P 247 L 10** Replace “shows” by “show”.
- P 247 L 13** Replace “ $\tau = 1$ ” by “ $\tau = 10$ ”.
- P 249 D 4** In equation (8.1), replace “ $\beta_i|D$ ” by “ $\beta_{i1}|D$ .”
- P 253 E 8.5** Replace “ $x'_{ij}$ ” by “ $x'_{i1}$ ”.
- P 254 E 8.6** Replace “ $Y_{i j-k}$ ” by “ $Y_{i(j-k)}$ .”
- P 254 L 12** Insert “figures” before “8.4(a) and 8.4(b).”.
- P 255 L -13** Replace “ $\beta_{i2}$ ” by “ $\gamma_{i2}$ ”.
- P 255 L -5** , Delete  $\beta_0$  giving “ $\text{Var}(Y_{ij}|\sigma^2, D)$ ”.
- P 256 L 5** Delete the “()” around  $D_{22}$ .
- P 259 D 2** For simplicity, label this as equation (8.1.5). This correlation matrix was supposed to be numbered, but wasn’t. The reference to it on line 14 incorrectly refers to (8.1.5), while 8.1.5 isn’t an equation number, other fixes are more painful.
- P 262 L -12** Close the “(” with a “)”. Replace “ $\text{Var}(Y_{ij}$  increases” by “ $\text{Var}(Y_{ij})$  increases.”
- P 262 L -4** Replace “the variances” with  $\text{Var}(Y_{ij})$ .
- P 265 D 2** Introduce “()” in the subscript for “ $\rho^2_{(j-1)}$ ” and in the subscript for  $x$ , replace “ $x'_{ij}$ ” by “ $x'_{i(j-1)}$ ”. On the next line (or line -12) the subscript for  $\rho^2$  is  $\rho^2_{(j-1)}$ .
- P 267** In equations (8.13), (8.14) twice and line -4, in the double subscripts, replace the second subscripts “ $j + 1$ ” or “ $j - 1$ ” by “ $(j + 1)$ ” or “ $(j - 1)$ ” for a total of 4 “()” insertions.
- P 268 L 2** Replace “ $\rho^2$ ” by “ $\rho^2$ ”.
- P 268 L -7** Close parenthesis, replacing “(8.11” by “(8.11)”.
- P 269 D 1** Replace “ $Y_{i j-k}$ ” by “ $Y_{i(j-k)}$ ” and “ $\delta_{i j-l}$ ” by “ $\delta_{i(j-l)}$ .”
- P 269 L -11** Replace “ $\beta_i$ ” by “ $\beta_{i1}$ ”.
- P 270 L -9** Replace “ $\beta_i$ ” by “ $\beta_{i1}$ ”.
- P 271 L -7** In the line after equation (8.18), replace “ $\beta_{ki}$ ” by “ $\beta_{ik}$ .”
- P 272 L 17** Insert “FA( $p$ )” after “factor analytic”.
- P 272 D 2** Replace  $K$  by  $p$  in the summation.
- P 273 L -21** Replace the two  $m_i$  by  $n_i$  giving  $\bar{Y}_i = n_i^{-1} \sum_{j=1}^{n_i} Y_{ij}$ .
- P 273 L -2** Replace “CS,, AR” by “CS, AR”.
- P 274 L 15** Replace  $\sigma^2_{jj}$  by  $\sigma_{jj}$
- P 274 L -12** Replace “ $R$  is as an” by “ $R$  is an”.

- P 275 T 8.1** Change model numbers; line 2 ANTEH should be model 10, FA(2) should be model 11, and FAH(1) should be model 12.
- P 278 T 8.4** In line 2, replace “ARH” by “ARH(1)”, and replace “ANTE” by “ANTEH(1)”.
- P 278 L 3** Replace “FAH” by “FAH(2)” and replace “ANTE(1)” by “ANTEH(1)”.
- P 278 L -17** Insert “of” right before “the fitted means”.
- P 279 T 8.5** FA(2) should be model 8 and FAH(1) should be model 9.
- P 287 L 6** In the title for 8.5.1, delete “Plus Independent Effect”.
- P 287 L -12, -7** Replace “noise” by “error”, and replace “ $\sigma^2$ ” by “ $\tau_2^2$ ” in “independent error  $\sigma^2 I$  is called”.
- P 287 D 3, 4** Replace  $\rho^{|k-j|}$  which assumes equally spaced observations with  $\rho^{|t_{ik}-t_{ij}|}$  which does not assume equally spaced observations.
- P 294 Pr 4 L 1.** Replace “the next three problems” with “this problem”.
- P 294 L -5** Change “chapter 2” to “chapter 7”.
- P 297 Pr 13** And problem 15 and problem 16, replace  $\mu$  by  $\alpha_1$ , a total of 4 times on lines 15, 17, 25, and 29.
- P 298 Pr 20** Replace the problem statement with “Show that the generalized normal kernel (GNK) covariance model is the same as the power AR (PAR) model, both from section 8.6.3.”
- P 307 L 1** “we have  $X_i$ ,  $n_i \times K$  not  $\times p$ .”
- P 309 L -1** Replace  $t_*$  by  $t_0$ .
- P 314 L -8– -6** Replace “In the discussion of figure 10.5(b), we saw” with “In figure 7.3(a), page 191, we see”. On L -7, change “included a decrease at weeks” to “includes a decrease in weight at weeks”. On L -7, -6, change “week 6 in the residuals.” with “week 6.”, deleting “in the residuals”. Finally, change “In table 7.4, we see” to “In table 7.4, on page 181, we see”
- P 318 L -13, -12** Replace “from regression” by “from the regression of”.
- P 319 D 2** Add parentheses to the expression in the sum. Replace “ $Y_{ij} - x'_{ij}\hat{\alpha}$ ” by “ $(Y_{ij} - x'_{ij}\hat{\alpha})$ ”.
- P 320 L -1** Replace “ $\beta_{i1}$ ” by “ $\beta_i$ ”. On line L -2, delete two commas.
- P 322 L 6,7 L 6,** Replace “with  $Z_i = 1$ , with “ $X_i = Z_i = 1$ ,”. L 7, Twice replace “ $\beta_i$ ” by “ $\hat{\beta}_i$ ”.
- P 323 F 9.3** Figure is wrong. The density drawn with a solid line should represent a  $N(124, 20)$  density and the density drawn in a dashed line should be a  $N(130, 5^2)$  density.
- P 329 L 15** Replace “Section 10.4 illustrates.” with “Section 10.4 illustrates this.”.
- P 332 L -18** Replace “ $\text{Var}(\alpha)$ ” by “ $\text{Var}(\hat{\alpha})$ ”.
- P 333 L 15** Replace “ $\hat{\beta}$ ” by “ $\hat{\beta}_i$ ” at the right end of the line.
- P 334 F 10.1 L 2 and 3** of the caption. Replace “E-residuals” by “Residuals  $d_{ij}$ ” twice.
- P 335 F 10.2 L 2 and 3** of the caption. Replace “E-residuals” by “Residuals  $d_{ij}$ ” twice.
- P 338 L 8** Replace the reference to “figure 2.2.4” by “figure 2.17 in Section 2.4.4”.
- P 345 L 10** At the beginning of the line replace “ $x_I\alpha$ ” by “ $x'_I\alpha$ .”
- P 345 L 13,15** Replace “ $\hat{V}(\alpha)$ ” by “ $V(\hat{\alpha})$ ”, twice.
- P 345 L 14** Replace “ $j$ th” by “ $k$ th”
- P 348 L 14** Replace  $.01 = .12/12$  with  $.004 \approx .05/12$  instead. (See Table 11.1 on page 347).
- P 348 L -10** Replace “ $\alpha_I$ ” by “ $\hat{\alpha}_I$ ”.
- P 348 L -2** Twice, replace  $\beta_i$  with  $\beta_{i1}$ .
- P 349** 13 times, replace  $\beta_i$  with  $\beta_{i1}$  on lines 6, 12, 13, 14, 16, 16, 19, 20, -4, -5, -9, -9, -16.
- P 350 F 11.1** In the caption, 4 times replace  $\beta_i$  with  $\beta_{i1}$  on lines 3, 4, 4, 6.
- P 351 L -15** Replace  $\beta_i$  with  $\beta_{i1}$ .
- P 352 L 17** Replace “ $\alpha_j$ ” by “ $\hat{\alpha}_j$ ”.
- P 352** Replace  $\beta_i$  with  $\beta_{i1}$  six times on lines -10, -11, -13, -14, -17, -17.
- P 353** Replace  $\beta_i$  with  $\beta_{i1}$  six times on lines 5, 7, 8, 11, 15.
- P 355 L -9** Replace “ $\exp(\alpha_{13})$ ” by “ $\exp(\hat{\alpha}_{13})$ ”.
- P 356 T 11.2** Last line of the table, replace  $\beta_i$  with  $\beta_{i1}$ .
- P 361 L 9, 10** Capitalize “Define” and “We” in the first two bullets of the Overview.
- P 371 L 8** Insert between the sentences “This is illustrated in Figure 12.1.”
- P 377 L 15,17** Replace “independent” by “uncorrelated”.

- P 379 L 19–20** Replace “actually identical to” with “essentially the same as” and replace “has the same standard errors.” with “the standard errors are similar.”.
- P 381 L 18** Insert a comma after the ellipsis “...” and right before  $n_i$ .
- P 381 L -10,-11** The second subscript on the last  $\alpha$  of each vector should be  $K$  not  $p$ , so  $\alpha_{YK}$  not  $\alpha_{Yp}$  and  $\alpha_{WK}$  not  $\alpha_{Wp}$ .
- P 382 L -4** Replace “ $K$ -values” by “ $p$ -values”.
- P 385 L 14** Change “compare” to “compared”, and replace “ $\beta_{iY_1t_{ij}}$ ” with “ $\beta_{iY_2t_{ij}}$ ”.
- P 386 T 13.5** L 4 of the caption, replace “(AR)” by “(AS).”
- P 387 T 13.6** Replace “ $\Sigma_{WW}$ ” by “ $\sigma_{WW}$ ”, “ $\Sigma_{WI}$ ” by “ $\sigma_{WI}$ ”, and “ $\Sigma_{II}$ ” by “ $\sigma_{II}$ ”.
- P 392** Last sentence before section 13.8. Replace “hypothesis that pain rating” with “hypothesis that the correlation between pain rating”.