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10. Corrections to Design and Analysis of Experiments

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Corrections to the first printing

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Design and Analysis of Experiments

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SAS code

SAS code as displayed in the text show single quotes as curled or slanted (e.g. `XAXIS LABEL = 'Treatment';`), but SAS syntax requires that they be vertical (e.g. `XAXIS LABEL = 'Treatment';`)

Chapter 6

p193. In exercise 3(b), change "plot (g)" to "plot (c)".

Chapter 9

p286. In line -3 (3rd last), interchange "$\mu + \tau_i$" and "$\mu^* + \tau_i$". Also, insert the following at the page bottom: "Henceforth, we dispense with the asterisk in model (9.2.2)."

p299. Change line -2 to, "The commands `drop1(model1, ~., test="F")` and `anova(model1)` generate the type 3 and type 1 sums of squares..."

Chapter 12

p420. Change the last two lines of code in Table 12.11 to be:

```
XAXIS LABEL = 'Treatment';
YAXIS LABEL = 'Adjusted Observations';
```

Corrections to the first printing

(Updated April 7, 2017)

Design and Analysis of Experiments

Angela Dean and Dan Voss

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Chapter 2

Page 14. Change "*Journal of Applied Statistics*" to "journal *Applied Statistics*".

Page 32 exercise 9. Change "volume of Applied Statistics" to "volume of *Applied Statistics*".

Chapter 3

Page 37. Add to the last paragraph "Also note that when notation involves both a sum and a square, such as $y_{..}^2$ or $\bar{y}_{i.}^2$, the sum is taken first and then the sum is squared."

Page 39. The last sentence should be, "The notation $\hat{\mu} + \hat{\tau}_i$ is used..."

Page 46. Line 3 is not a new paragraph.

Page 51, step (h), "See Example 3.6.1", not Example 3.6.2.

Page 52. Change item (c) near the page bottom to be as follows.

(c) For the required power $\pi(\Delta)$, we use Table A.7 to determine ϕ and take the larger listed value if necessary.

Page 53. In the tabular material at the end of Example 3.6.1, change 2.48 to 2.67 and 4.13 to 4.79.

Page 55. Line 3. Change $r_i = 4$ to $r_1 = r_2 = r_3 = 4$.

Page 55. Replace the calculations for ssT to be as follows.

Using the values for $\bar{y}_{i.}$ given above, together with $\Sigma\Sigma y_{it}^2 = 45.7397$ and $r_1 = r_2 = r_3 = 4$, the sums of squares for Soap and Total are calculated using (3.5.14) and (3.5.18), as

$$
\begin{aligned}
ssT &= \sum_i r_i \bar{y}_{i.}^2 - y_{...}^2/n \\
&= [4(-0.0350)^2 + 4(2.7000)^2 + 4(1.9925)^2] - (18.63)^2/12 = 16.1220,
\end{aligned}
$$

Page 55. Replace the calculations for ssE to be as follows:

$$
\begin{aligned}
ssE &= \sum_i \sum_t y_{it}^2 - \sum_i r_i \bar{y}_{i.}^2 \\
&= 45.7397 - [4(-0.0350)^2 + 4(2.7000)^2 + 4(1.9925)^2] = 0.6946.
\end{aligned}
$$

Page 62. In Table 3.11, the first observation is 22.0, not 22.4.

Page 63 Delete Question 14e

Chapter 4

Page 69 Line -4. Reference should be to Example 3.4.2 not 3.4.4.

Page 71 Line 7. Replace "by over two hours" with "by over four hours".

Page 72 Line 1. Reference should be to Example 3.4.1 not 3.4.4.

Page 74 Line 1 of Example. Reference should be to Example 3.4.1 and Example 4.2.3 not 3.4.4 and 4.2.4.

Page 75 Line 2 of Example. Reference should be to Example 3.4.1 not 3.4.4.

Page 77 Line -5. Replace 3.675 by 3.508.

Page 77. When written in full, the denominator in ssc/mse is

$$
\frac{ssc}{msE} = \frac{\left[\frac{1}{3}(\bar{y}_{1.} + \bar{y}_{4.} + \bar{y}_{7.}) - \frac{1}{4}(\bar{y}_{2.} + \bar{y}_{3.} + \bar{y}_{5.} + \bar{y}_{6.})\right]^2}{msE\left[\frac{(\frac{1}{3})^2}{3} + \frac{(\frac{1}{3})^2}{3} + \frac{(\frac{1}{3})^2}{3} + \frac{(-\frac{1}{4})^2}{3} + \frac{(-\frac{1}{4})^2}{3} + \frac{(-\frac{1}{4})^2}{3} + \frac{(-\frac{1}{4})^2}{3}\right]} > F_{1,14,\alpha}.
$$

Page 84 Line 5. Reference should be to Example 4.4.1 not 4.4.2.

Page 84 Line 7. Reference should be to Example 4.4.1 not 4.4.2.

Page 85 line 5. Change "intervals that" to "intervals for treatment contrasts that".

Page 88. The comments on the one-sided bounds are wrong. Below (4.4.29), it should say, "If the right hand side of (4.4.29) is positive, we infer that the ith experimental treatment gives a larger response than the control." Also, below (4.4.30), it should say "If the right-hand side is negative, we infer that the ith experimental treatment gives a smaller response than the control."

Pages 94–95. Switch order of "Contrast" and "estimate" statements in Table 4.2 to match the output in Table 4.3. Correspondingly change line numbers in Table 4.2 and on lines -1 of page 94 and -6 of page 95. (SAS output automatically lists output of "contrast" statements before output of "estimate" statements regardless of their order in the SAS program.)

Pages 96–97. Change "upper" to "lower" on page 96 line -3 and "lower" to "upper" on page 97 line 1.

Page 98. The one-sided alternative hypothesis should read

$$H_A : \ (\tau_1 + \tau_2 + \tau_3)/3 \ - \ \tau_0 < 0$$

Page 100 Question 11 change wording. Replace "repeat" by " conduct an experiment similar to".

Chapter 5

Page 105. In the 4th last line, change "Example 5.2.2" to "Figure 5.1".

Chapter 6

Page 135. In line 9 of the Introduction, remove "a" from "...the a 2-digit code..."

Page 136. Line 14 of Section 6.2.1 should refer to "Page 12" not "Page 7".

Page 148, line 17. "Using (6.4.17)" should read "Using (6.4.16)".

Page 150. The α level is in error. Also, the critical coefficient should be called w_B. So, above Figure 6.4, it should say, "...$w = w_B = t_{(18-6),0.005} = 3.055$, giving

$$\begin{aligned} \alpha_2^* - \alpha_1^* \ &\in \ \left(\bar{y}_{2..} - \bar{y}_{1..} \pm w_B \sqrt{msE \ (1/br + 1/br)} \right) \\ &= \ 0.0723 \pm (3.055)\sqrt{0.000289(2/9)} \ = \ (0.0478, 0.0968) \ ." \end{aligned}$$

Page 151. Line 2 should read, "...between 0.0478 and 0.0968 seconds faster..."

Page 151. Line 7 reference should be to "Example 6.4.4", not "Example 6.4.3".

Page 151, Example 6.4.4, line 8, change "treatment combinations" to "levels of either treatment factor, using $\alpha = 0.05$.

Page 152. The third equation should have d_{ij}^2, not d_{ij}

Page 154. The last display should contain y_{ijt}^2 instead of y_{ijt} to read

$$ssE = \sum_i \sum_j \sum_t y_{ijt}^2 - \sum_i \sum_j y_{ij.}^2 / r.$$

Page 156. Line 5. Alternative hypothesis is H_A^A not H_0^A.

Page 168. In the first line of Section 6.6, change "In Chapter 3,..." to "In Chapters 3 and 4,..."

Page 170. Last line. Reference should be to Example 6.3.1 not 6.3.2.

Page 186. Problem 11. In line 2, change "treatment combinations" to "levels of either treatment factor". In line 3, change "probability 0.9" to "probability 0.9 for $\alpha = 0.05$".

Page 191. Table 6.24. Table caption should say "Data for water boiling experiment, in minutes. (Order of observations is given in parentheses)."

Page 191. Problem 21d. Replace "...this observation." with "...this observation, but do the test in part (c) for the linear contrast only. (The formula for the linear contrast coefficients is given in (4.2.4) on page 71.)"

Chapter 7

Page 232–233 Line -3. For Exercise 5, change the 3rd last line to be, "... in Table 7.18. The error mean square was calculated to be 6.598 with 36 degrees of freedom."

Page 234. In Exercise 7, in the line above part (a), change "n" to "in".

Page 237. In Exercise 10d, delete " at least".

Page 241. Question 15c. Change "×100" to "×1000".

Page 288, lines 5–8. The corresponding six (not four) confidence intervals also include:

$$\tau_4 - \tau_1 \in (-3.936, 3.794), \quad \tau_2 - \tau_3 \in (-3.573, 4.181)$$

Chapter 9

Page 279. In lines 1–2, interchange "$\mu + \tau_i$" and "$\mu^* + \tau_i$". Also, insert the following before section 9.2.1: "Henceforth, we dispense with the asterisk in model (9.2.2)."

Chapter 10

Page 300, Line 6 of Example 10.3.2.   Interchange 50% and 100% to read "Two levels of capacity were selected, 100% and 50%. "

Page 300, Line 6 of Example 10.3.2.   Change period to comma to read "... combinations in total, which..."

Page 300, Lines 8,9 of Example 10.3.2.   Interchange 50% and 100% so that the display reads

(100%, Brand 1) = 1   (100%, Brand 2) = 2   (100%, Brand 3) = 3
(50%, Brand 1) = 4   (50%, Brand 2) = 5   (50%, Brand 3) = 6

Page 302. In Table 10.3, under "Mean Square", change "$ss\theta$" to "$ms\theta$" so that it reads " $ms\theta = ss\theta/b - 1$.

Page 308. Below the display calculating "msd", the following changes need to be made.

treatment 1 should read "ordinary flyer, 1.69 twist".

treatment 2 should read "ordinary flyer, 1.78 twist".

treatment 6 should read "special flyer, 1.78 twist".

Page 309. In Figure 10.3, change "$\overline{y}_{hi.}$" to "$\overline{y}_{.i}$",

Page 311. In Example 10.6.1, the reference in line 2 should be to "Example 10.3.2, page 300" not to "Ex 10.3.4 page 311."

Page 311, Lines 4,5 of Example 10.6.1.   Interchange 50% and 100% so that the display reads

(100%, Brand 1) = 1   (100%, Brand 2) = 2   (100%, Brand 3) = 3
(50%, Brand 1) = 4   (50%, Brand 2) = 5   (50%, Brand 3) = 6

Page 312, Lines 5, 6 below table.   Interchange 50% and 100% so that it reads "Consequently, Figure 10.4 suggests that treatments 1 and 2 are better than treatment 3 at 100% capacity. These treatments correspond to Brands 1 and 2 which are the more expensive brands. The position is less clear for 50% capacity. These contrasts will be examined in detail in Example 10.6.2."

Page 313. Line 7 should be $w_T = q_{v,n-v-b+1,\alpha}/\sqrt{2}$

Page 314. The 7th last and 5th last lines should have "(60 watt bulbs, day 1)" and "(100 watt bulbs, day 2)", not 50 watt in each case.

Page 314 Line 20.   Replace 100% by 50%.

Page 314 last 2 lines and Page 315 first 2 lines.   Interchange the description about 50% and 100% bulbs, so that it reads as follows:

"Now, if we assume that most bulbs are used at 100% capacity and not on a dimmer switch, we find that Brands 1 and 2 were each better than Brand 3 in both blocks, but not significantly different from each other. At 50% capacity, the only difference that we find is a difference between Brands 1 and 2 in block 1, with Brand 2 being superior. Putting together all this information might lead one to select Brand 2 for most illumination purposes, unless cost was an important factor."

Page 322. On page 322 at the end first paragraph (in line 4), insert "(See Table 10.16.)". At the end of the second paragraph (in the 7th last line), insert "(See Table 10.17.)".

Page 325. Qu3. In line 2 of the question the value of twist should be 1.69, not 1.63.

Page 330, line 4. Change "...hand, and the one..." to '...hand, and one..."

Page 330. Qu11. Change factor levels in Table 10.24 from 0, 1, 2 to 1, 2, 3, consistent with experiment description.

Page 332. Qu13. In last line, change "Sample fraction" to "Sampling fraction".

Page 335. Table 10.28. Change last entry from "36)" to "(36)".

Page 336. Table 10.29. Delete the heading "(order)" in three places.

Chapter 11

Page 344. Line 2, Reference to "Example 11.2.2" should be "Example 11.2.1"

Page 359. Line 5, upper limit on first sum is 9, not 8. Line 7, upper limit on both sums is 9, not 8.

Page 359. In the middle of page 359, after the display

$$11.375 \pm \sqrt{8F_{8,16,0.01}}\sqrt{0.3075} = 11.375 \pm 3.093 = (8.282, 14.468).$$

add the sentence "showing that the control detergent washed between 8.3 and 14.5 more plates that the other detergents on average."

Page 371, line 10. The upper limit on both sums is d, not v.

Page 374. Line 4 below table. "Section 6.8, page 175" should be "Section 6.8.1, page 177".

Page 374. Line 10 is missing. Lines 9–10 should be, "Partial output is shown in Table 11.18."

Page 380, exercise 9. Change the treatment factor levels from 0,1,2,3 to 1,2,3,4, consistent with Table 11.23.

Page 382. In exercise 12(b), change "$\overline{y}_{i.} - \overline{y}_{p.}$" to "$\overline{y}_{.i} - \overline{y}_{.p}$"

Chapter 12

Page 392, para 3, line 4. Change " but allows" to "but may allow".

Page 393. In the paragraph above Example 12.2.1, the second sentence should be as follows. "Treatment 1, for example, appears in one block with each of treatments 3 and 4, in two blocks with 2 and 7, and not at all with treatments 5, 6, or 8."

Pages 404–405. The simultaneous 95% confidence intervals in Example 12.5.2 are for $\tau_2 - \tau_1$, $\tau_3 - \tau_1$, and $\tau_3 - \tau_2$, respectively.

Page 410, second model. Delete extra "+"

Page 410, Section 12.9, last line. Change "it would be possible" to "it may be possible".

Page 419. Augment the Table 12.15 caption to include, "—data are 'true number' minus 'guessed number' "

Chapter 13

Page 422. The fifth line of section 13.2.1 should read, "A factorial experiment is called *symmetric* if all factors..."

Page 426. Line -4 and -5. Switch +1 and -1. (In other words, it should be "... +1 appear in Block I..." and "... −1 appear in Block II...".)

Page 431.

The bottom section of Table 13.7 should be as follows.

Block	Contrast Coefficients $(ABCD, ABC)$	Treatment Combinations			
I	$(-1,-1)$	0001	0111	1011	1101
II	$(-1,\ 1)$	0010	0100	1000	1110
III	$(\ 1,-1)$	0000	0110	1010	1100
IV	$(\ 1,\ 1)$	0011	0101	1001	1111

Also, change the second paragraph below Table 13.7 to say that, "...the treatment combinations in Block I and Block IV have the fourth digit equal to 1, and all of those in Blocks II and III have the fourth digit equal to 0."

Page 436, Example 13.4.1. L_3 in the display should be $L_3 = a_1 + a_4 + a_6$ to match the ADF contrast selected.

Page 443. Line -8. replace "repeating" by "using".

Page 448, line -4. Change 2667.04 to 2667.04/56,546.07, which is 0.0472—less than the F value.

Page 451, Table 13.18, change "110" to "010" in block X.

Page 474, Example 14.4.2, line 6, change "two blocks of the design d_2" to "three blocks of the design d_2".

Chapter 15

Page 485. Half way down the page should read: This "$A = BC$" contrast is equal to...

$$= [-\overline{\tau}_{0..} + \overline{\tau}_{1..}] + \frac{1}{2}[\overline{\tau}_{.00} - \overline{\tau}_{.01} - \overline{\tau}_{.10} + \overline{\tau}_{.11}].$$

Page 486. Half way down the page should read: The estimable A contrast in the three-way model is of the form...

$$= [-\overline{\tau}_{0..} + \overline{\tau}_{1..}] - \frac{1}{2}[\overline{\tau}_{.00} - \overline{\tau}_{.01} - \overline{\tau}_{.10} + \overline{\tau}_{.11}],$$

Page 503. Example 15.5.1. Label this "Flour experiment number 3", not "Flour experiment"

Page 504, Table 15.17, change end of table heading from "and experiment" to "for flour experiment number 3"

Page 507. Lines 7 and 8. Replace "$p = 8$ rows and $p - 1 = 7$ columns" by "$2^p = 8$ rows and $2^p - 1 = 7$ columns".

Page 508. In Table 15.23, the second-last entry in the last column should be -1, not 1.

Page 510, three lines above Table 15.26. Should read "The contrast estimates for factors A and H are considerably larger in absolute value".

Page 511. In Table 15.26, the levels of factor A—namely, the first column of digits in the table—should be eight zeroes followed by eight ones, not 16 zeroes.

Page 512. In Table 15.27, the contrast estimates should be as follows.

Contrast	A	B	C	D	E	F	G	H
Estimate	0.352	0.122	0.105	-0.249	-0.012	-0.072	-0.101	-0.566

Page 512. In Table 15.28, change the signs of the estimates for contrasts A–G (but not for H).

Page 517. In line 7, change "Under designled experimental conditions, it was possible..." to "For the experiment, it was possible..."

Page 525. In the SAS program, add the code line below to each `PROC GLM` call, in view of comments on page 526.

```
LSMEANS A B C D E F G;
```

Page 530, exercise 3. Lines 6–7 should read, "The data for the first replicate of the original experiment were given in Table 15.46 (page 468) and the first block of data is reproduced in Table 15.46." The last sentence should start, "Analyze the data of Block I..."

Pages 531, 533, 535, 537, 539, and 541. The page heading should be "Exercises", not "15.8 Using SAS Software"

Page 531 Ex 5. Call this "Flour experiment number 3, continued."

Page 535 Ex 8. The design in Table 15.50 should be as follows.

Block	A B C D E F G H J K L M N	Repl. I	Repl. II
II	0 0 0 0 1 1 1 1 1 0 0 0 0	1511	1506
I	1 0 0 0 0 0 1 1 0 1 1 0 0	375	370
I	0 1 0 0 1 1 0 0 0 1 0 1 0	392	392
II	1 1 0 0 0 0 0 0 1 0 1 1 0	523	520
I	0 0 1 0 0 1 0 1 0 0 1 1 1	481	479
II	1 0 1 0 1 0 0 1 1 1 0 1 1	2238	2230
II	0 1 1 0 0 1 1 0 1 1 1 0 1	550	551
I	1 1 1 0 1 0 1 0 0 0 0 0 1	546	542
I	0 0 0 1 1 0 1 0 1 1 1 1 1	369	367
II	1 0 0 1 0 1 1 0 0 0 0 1 1	2242	2243
II	0 1 0 1 1 0 0 1 0 0 1 0 1	584	592
I	1 1 0 1 0 1 0 1 1 1 0 0 1	446	447
II	0 0 1 1 0 0 0 0 0 1 0 0 0	1776	1782
I	1 0 1 1 1 1 0 0 1 0 1 0 0	1053	1059
I	0 1 1 1 0 0 1 1 1 0 0 1 0	462	463
II	1 1 1 1 1 1 1 1 0 1 1 1 0	582	582

Page 536 Ex 9. Call this " Flour experiment number 1", not " Flour experiment, continued"

Page 536 Ex 9. Reference should be to Example 15.5.1 not Example 15.5.

Page 538, exercise 10, should read as follows. "The orthogonal array in Table 15.23 was selected with columns 1–6 labeled A, B, D, C, E, F. Columns 4–6 were multiplied by -1. One degree of freedom (corresponding to column 7) is available to measure σ^2 or one of the two-factor interactions."

Chapter 16

Page 547. Delete the last sentence on the page—namely, "The levels at which the observations were taken are marked on the plot."

Page 555. Change n to be n_d under (16.2.8).

Page 554. Example 16.2.2 line 1. The paint experiment was introduced in Example 16.2.1 not 16.2.3.

Page 555. Example 16.2.3 line 1. The paint experiment was introduced in Example 16.2.1 not 16.2.3.

Page 548, line -6. Change "(as illustrated in Figure 16.1)." to "(as suggested by Figure 16.1)."

Page 558. In Example 16.2.4, line 5, should have cathodic current density as factor B and anode-cathode separation as factor A, so that it reads " ... to study the effect of anode-cathode separation (factor A) and cathodic current density (factor B) on the standard deviation of coating thickness."

Page 559. The reference at end of Example 16.2.4 should be to Example 16.3.1.

Page 563. The reference in line 1 of Example 16.3.1 should be to Example 16.2.4, page 558.

Page 563, Example 16.3.1. The experimenters chose α to be approximately equal to $\sqrt{2}$, but not exactly. In Table 16.9, the entries $\sqrt{2}$ for "Anode-cathode separation" (Factor A) should be 1.5, and the entries $\sqrt{2}$ for "Current density" (Factor B) should be 1.4.

Page 563, Example 16.3.1. should have cathodic current density as factor B and anode-cathode separation as factor A, so that it reads " ... to study the effects of anode-cathode separation (factor A) and cathodic current density (factor B) on the standard deviation of a copper-plating thickness."

Page 564. The last sentence of Section 16.3.3 should refer to Example 16.3.2, not 16.3.4.

Page 565, Example 16.3.2. In line 2, change "for these data" to "for the coded data". Also, delete the sentence "The same analysis...levels" in lines 3–4.

Page 566. In lines 2 and 3, the center points are 4.32 and 4.25, which have sample variance 0.00245. This

gives $F = 19.299$ for the lack-of-fit test. This is still not significant, with $P > 0.10$. The text at the top of page 566 should say:

"Before settling on a final model, we should check the lack of fit of the second-order model. The only replication consisted of two center-point observations with values 4.32 and 4.25. The sample variance of these two observations is $s_0^2 = 0.00245$, so $ssPE = 0.00245$ with one degree of freedom. From the analysis of variance table, Table 16.11, we see that $ssE = 0.1443$ with 4 degrees of freedom. So,

$$ssLOF = ssE - ssPE = 0.1443 - 0.00245 = 0.14185$$

with $4 - 1 = 3$ degrees of freedom for lack of fit. There is significant lack of fit of the second-order model if

$$msLOF/msPE > F_{3,1,\alpha} \,,$$

for appropriate significance level α. Here,

$$msLOF/msPE = (0.14185/3)/(0.00245/1) = 19.299 \,,$$

which is less than $F_{3,1,0.10} = 53.6$, so there is no significant lack of fit of the second-order model, and the model fitted in Example 16.3.2, page 563, should be a reasonable approximation to the true surface in the local region under study ($9.5 \le x_A \le 11.5$; $31 \le x_B \le 41$). □"

Page 568. In Example 16.3.3, line 3 should have cathodic current density as factor B and anode-cathode separation as factor A, so that it reads " ... to study the effect of anode-cathode separation (factor A) and cathodic current density (factor B) on the standard deviation of copper-plating thickness."

Page 573 PAH expt. Reference to Table 16.19 should be page 581, not page 582.

Pages 580–584. Delete the parenthetical remark "(see page 58#)" under each table.

Page 587. In Table 16.25, row 15 should have Yield = 13.0, not 13..0

Chapter 17

Page 604, line -2. Reference should be to Examples 17.3.1 and 17.3.2, not to Examples 17.3.3 and 17.3.4.

Page 606, line 2 of Example 17.3.4. Reference should be to Examples 17.3.1 and 17.3.2, not to Examples 17.3.3 and 17.3.4.

Page 609, Example 17.4.1, line 2. Should be H_A, not H_0.

Page 616. Line 13 should read

$$u = (msB - ms(AB) - ms(BD) + msE)/adr$$

so that the signs match those of the estimator U.

Page 623. Equation (17.7.25) should have Y_{ijkt}, not Y_{ijt}

Page 626. Lines 9, 11 and 19 should be as follows, respectively.

$$\widehat{\alpha}_i^* - \widehat{\alpha}_p^* = \left(\widehat{\alpha}_i + \widehat{(\alpha\beta)}_{i.}\right) - \left(\widehat{\alpha}_p - \widehat{(\alpha\beta)}_{p.}\right) = \overline{y}_{i...} - \overline{y}_{p...}$$

$$\widehat{\beta}_j^* - \widehat{\beta}_u^* = \left(\widehat{\beta}_j + \widehat{(\alpha\beta)}_{.j}\right) - \left(\widehat{\beta}_u + \widehat{(\alpha\beta)}_{.u}\right) = \overline{y}_{.j..} - \overline{y}_{.u..} \,.$$

$$\text{Var}(Y_{ijkt}) = \sigma_D^2 + \sigma_{BD}^2 + \sigma^2 \quad \text{and} \quad \text{Var}(\overline{Y}_{.j..}) = \frac{\sigma_D^2}{d} + \frac{\sigma_{BD}^2}{d} + \frac{\sigma^2}{adr} \,.$$

Page 631. Table 17.11 should have $mse = 802.57$.

Page 632. In line 3 of section 17.10.1, change "$r = 11$" to "$r = 4$"

Pages 633–635. The following 3 changes are needed to correct Figure 17.5 so that it plots the treatment averages rather than the predicted values.
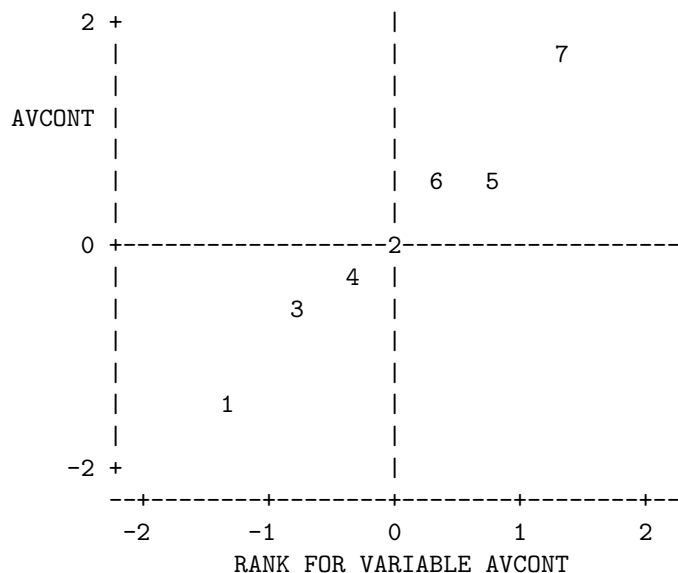
First, delete "—namely, the standardized predicted values—" from the sentence ending page 633 and starting page 634.

Secondly, replace Table 17.12 with the following.

```
 PROC SORT;  BY BALE;
 PROC MEANS NOPRINT;  BY BALE;
    VAR CONTENT;
    OUTPUT OUT=WOOL2 MEAN=AVCONT;
 PROC STANDARD STD=1.0 MEAN=0.0;
    VAR AVCONT;
 PROC RANK NORMAL=BLOM;
    VAR AVCONT;
    RANKS NSCORE;
 PROC PLOT;
    PLOT AVCONT*NSCORE=BALE / VPOS=15 HPOS=40 HREF=0 VREF=0;
```

Thirdly, replace Figure 17.5 with the following.

```
                        The SAS System
          Plot of AVCONT*NSCORE.   Symbol is value of BALE.


        2 +                      |
          |                      |
          |                      |              7
   AVCONT |                      |
          |                      |
          |                      | 6    5
          |                      |
        0 +------------------2---------------------
          |                4 |
          |              3   |
          |                  |
          |                  |
          |       1          |
          |                  |
       -2 +                  |
          --+--------+--------+--------+--------+--
           -2       -1        0        1        2
                    RANK FOR VARIABLE AVCONT
```

Page 638 line 3. Change "(Example 17.3.3, page 600)" with "(Example 17.3.1, page 600)". Also, Figure 17.6 is not quite correct, as the model fit included the linear order covariate and should not. In either case, the quadratic pattern is apparent. The SAS program ice.sas has been corrected on the web.

Page 639. Qu1 line2. Insert after "concentrations" the units as follows "concentrations (mg/ml)".

Page 640 Question 1d. Change "less than twice" to "at most five times".

Page 640 Question 2. At the end of question 2, insert the following: "(Note: $F_{150,150,.05} = 1.309, F_{160,160,.05} = 1.298, F_{170,170,.05} = 1.288, F_{180,180,.05} = 1.279,$)."

Rewrite lines 1 and 2 of the question as follows: "As in Example 17.4, page 609, suppose the ice-cream experiment is to be repeated, with $\gamma = 1.0$ and with a Type I error probability of $\alpha = .05$."

Page 641 Question 4e. Insert after "not negligible." the following: "Interpret your conclusions in terms of the plot in part (d)."

Page 642 Delete Question 6b.

Page 643 Qu 8. The first reference should be to "Example 17.3.1" not "Example 17.3.3". The next set of references should be to "Examples 17.3.2 – 17.3.4 and 17.4.1" not "Examples 17.3.4 – 17.3.5 and 17.4".

Page 643 Qu 8c. Should read "Redo the analyses of Examples 17.3.3 and 17.3.4 for the new model...".

Page 664. In the second call of GLM, replace the `LSMEANS` statement with the SAS code below. The error term for comparing levels of SETTING is still not quite correct, but one would need to use `PROC MIXED` for example to do better.

```
LSMEANS TESTING / PDFIFF=ALL CL ADJUST=TUKEY ALPHA=0.05;
* The following should be approximately correct;
LSMEANS SETTING / PDFIFF=ALL CL ADJUST=TUKEY ALPHA=0.05 E=REGUL(SETTING);
```

Page 670 Qu 6c. Should read "Using the data in Table 18.11...".

Page 671, Qu 8. "Erythrocite" should be spelled as "erythrocyte" throughout (including the experiment index).
smallskip Line 7.   Replace "selected at random from each trough and divided between two counting chambers. The erythrocite counts were then measured." with the following: "selected at random from each trough and the erythrocyte count from the blood of each fish was measured in two different counting chambers, giving two measurements per fish".

In the model, the variances should be $\sigma^2_{B(A)}$ and $\sigma^2_{C(AB)}$, not σ^2_B and $\sigma^2_{C(A)}$. Also, modify limits on k and t to $t = 1, 2; \quad k = 1, \ldots, 5$, and delete the subscript l from the model.

Chapter 18

Page 653. The model indices should also include "$u = 1, 2$;"

Page 659, Example 18.4.2; Second line of model.   Add a term $+(\alpha D)_{iu}$ so that the model reads

$$Y_{ijkut} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + C_{k(j)} + (\alpha C)_{ik(j)} + D_u$$
$$+ (\alpha D)_{iu} + (\beta D)_{ju} + (\alpha\beta D)_{iju} + \epsilon_{ijkut}$$

Page 659, Example 18.4.2; Third line of model should read $D_u \sim N(0, \sigma^2_D)$ not $D_u \sim N(0, \sigma^2_A)$. Also, add $(\alpha D)_{iu} \sim N(0, \sigma^2_{AD})$ so that the third line reads

$$C_{k(j)} \sim N(0, \sigma^2_{C(B)}) ; \quad (\alpha C)_{ik(j)} \sim N(0, \sigma^2_{AC(B)}) ; \quad D_u \sim N(0, \sigma^2_D) ; \quad (\alpha D)_{iu} \sim N(0, \sigma^2_{AD})$$

Page 660 line 5. Insert $(\alpha D)_{iu}$ so that the line reads "... and $(\alpha D)_{iu}, (\beta D)_{ju}$ and $(\alpha\beta D)_{iju}$ are respectively the interactions of the uth soil location with the ith method of analysis, the uth soil location with the jth laboratory and the three-factor...".

Page 660 line 13. Replace 106 by 104 in the degrees of freedom for the F-value.

Page 660 line 14. Insert AD to read "..., we may wish to examine the AB, AD and BD interactions."

Page 660 line 18. Before "To obtain a suitable denominator..." insert "The test for the AD interaction is similar."

Page 660 line 22.   Replace $18\sigma^2_{AC(B)}$ by $6\sigma^2_{AC(B)}$

Page 660 line 26.   The third term in the denominator should be divided by 104 not 106.

Page 661. Table 18.5 Replace $18\sigma^2_{AC(B)}$ with $6\sigma^2_{AC(B)}$ FIVE times in the expected mean squares column.

Page 661. Table 18.5 The expected mean square for A should include a term $24\sigma^2_{AD}$ to read

$$Q(\alpha, \alpha\beta) + 18\sigma^2_{AC(B)} + 24\sigma^2_{AD} + 6\sigma^2_{ABD} + \sigma^2$$

Page 661. Table 18.5 The expected mean square for D should include a term $24\sigma^2_{AD}$ to read

$$48\sigma^2_D + 24\sigma^2_{AD} + 12\sigma^2_{BD} + 6\sigma^2_{ABD} + \sigma^2$$

Page 661. Table 18.5   The top half of the table should include a line for AD between the lines for D and BD, so that we have

D	$d-1=2$	$48\sigma_D^2 + 24\sigma_{AD}^2 + 12\sigma_{BD}^2 + 6\sigma_{ABD}^2 + \sigma^2$
AD	$(a-1)(d-1)=2$	$24\sigma_{AD}^2 + 6\sigma_{ABD}^2 + \sigma^2$
BD	(b-1)(d-1)=6	$12\sigma_{BD}^2 + 6\sigma_{ABD}^2 + \sigma^2$

Page 661. Table 18.5. The error degrees of freedom should be 104, not 106.

Page 661. Table 18.5   The bottom half of the table should include a line for AD between the lines for D and BD; Also correct the second term of ssAD to sum over i, not j; Also correct the number in front of the third term in the sum of squares for ABD from 36 to 24; so that we have:

$$ssD \quad = \quad 48\Sigma_u \bar{y}_{...u.}^2 - 144\bar{y}_{.....}^2$$

$$ssAD \quad = \quad 24\Sigma_i \Sigma_u \bar{y}_{i..u.}^2 - 72\Sigma_i \bar{y}_{i....}^2 - 48\Sigma_u \bar{y}_{...u.}^2 + 144\bar{y}_{.....}^2$$

$$ssBD \quad = \quad 12\Sigma_j \Sigma_u \bar{y}_{.j.u.}^2 - 36\Sigma_j \bar{y}_{.j...}^2 - 48\Sigma_u \bar{y}_{...u.}^2 + 144\bar{y}_{.....}^2$$

$$ssABD \quad = \quad 6\Sigma_i \Sigma_j \Sigma_u \bar{y}_{ij.u.}^2 - 18\Sigma_i \Sigma_j \bar{y}_{ij...}^2 - 24\Sigma_i \Sigma_u \bar{y}_{i..u.}^2 - 12\Sigma_j \Sigma_u \bar{y}_{.j.u.}^2$$

Page 665, last 4 lines. This is an 80% confidence interval, not 90%, and both F critical values in the second last line should have generic degrees of freedom ν_1 and ν_2, not just the first critical value.

Page 669. Qu 4   In the model, the variances should be $\sigma_{B(AC)}^2$ and $\sigma_{BD(AC)}^2$, not σ_B^2 and σ_{BD}^2.

Page 669. Qu 4 In the second line below the model, it should read "$B_{k(ij)}$ represents the effect of the kth randomly selected batch of the jth bar size from the ith vendor, and . . ."

Page 669. Qu 4   In part (b), the variance should be $\sigma_{B(AC)}^2$, not σ_B^2

Page 669 Qu 4c Replace the null hypothesis

$$H_0 : \{\text{no differences in yield strength of the titanium alloy}$$
$$\text{can be attributed to the two test specimens}\}$$

with the null hypothesis

$$H_0 : \{\text{no differences in yield strength of the titanium alloy}$$
$$\text{can be attributed to the four vendors}\}.$$

Page 670. Qu 6.   Line 6 should say "sliced from".

Page 670 Qu 6c. Should read "Using the data in Table 18.11. . .".

Page 671. Qu 8.   In the model, the variances should be $\sigma_{B(A)}^2$ and $\sigma_{C(AB)}^2$, not σ_B^2 and $\sigma_{C(A)}^2$

Page 671, Qu 8. "Erythrocite" should be spelled as "erythrocyte" throughout (including the experiment index).

Page 671. Qu 8. Erythrocyte expt.   Modify limits on k and t to $t = 1, 2; \quad k = 1, \ldots, 5$.

Page 671. Erythrocyte expt. line 7.   Replace "selected at random from each trough and divided between two counting chambers. The erythrocite counts were then measured." with the following:
"selected at random from each trough and the erythrocyte count from the blood of each fish was measured in two different counting chambers, giving two measurements per fish".

Page 672 line -2. Add distribution for $(\alpha C)_{ik(j)}$ so that it reads

$$\epsilon_{ijkt} \sim N(0, \sigma^2); \quad C_{k(j)} \sim N(0, \sigma_{C(B)}^2); \quad (\alpha C)_{ik(j)} \sim N(0, \sigma_{AC(B)}^2);$$

Chapter 19

Page 677. Two lines above equation (19.2.1), "Bb" should be "B"

Page 679. The third formula in the first column at the bottom of Table 19.2 is for ssE_W, not E_W.

Page 687, second to last paragraph. ". . . in Table 19.10. The Type I sums of squares are listed,. . ."

Page 687, line 4 from bottom. Change the sentence beginning "The hypothesis tests. . ." to "The correct hypothesis tests are listed in the bottom half of the output."

Page 694. Change part (a) to be, "Sketch an outline analysis of variance table for the average response of the length data for this experiment,. . . ."

Tables

Page 722. The footnote of Table A.10 should begin, "Values w_{D2}...

Index of Experiments

Page 733. The "cotton spinning" experiment should have an entry for page 306.

Page 733. "erythrocite" should be spelled as "erythrocyte".

Page 734. The "resting metabolic rate" experiment should be listed as page 302, not 325.

Page 734. The "soap" experiment should have an entry for page 58.

Index of Subjects

Page 737. At page top left, "bf E" should be "**E**".

Corrections to the second and subsequent printings

Chapter 2

Page 14. Change "*Journal of Applied Statistics*" to "journal *Applied Statistics*".

Page 32 exercise 9. Change "volume of Applied Statistics" to "volume of *Applied Statistics*".

Chapter 3

Page 37. Add to the last paragraph "Also note that when notation involves both a sum and a square, such as $y_{..}^2$ or $\bar{y}_{i.}^2$, the sum is taken first and then the sum is squared.

Page 39. The last sentence should be, "The notation $\hat{\mu} + \hat{\tau}_i$ is used..."

Page 46. Line 3 is not a new paragraph.

Page 48 Line 6. References should be to Example 3.4.2 not 3.4.4.

Page 51, step (h), "See Example 3.6.1", not Example 3.6.2.

Page 52. Change item (c) near the page bottom to be as follows.

  (c) For the required power $\pi(\Delta)$, we use Table A.7 to determine ϕ and take the larger listed value if necessary.

Page 53. In the tabular material at the end of Example 3.6.1, change 2.48 to 2.67 and 4.13 to 4.79.

Page 55. In Table 3.7, $ssE = 0.6946$, not 0.6945.

Page 55. $ssT = \cdots = 16.1220$, not 16.12210

Page 62. In Table 3.11, the first observation is 22.0, not 22.4.

Chapter 4

Page 69 Line -4. Reference should be to Example 3.4.2 not 3.4.4.

Page 71 Line 7. Replace "by over two hours" with "by over four hours".

Page 72 Line 1. Reference should be to Example 3.4.1 not 3.4.4.

Page 74 Line 1 of Example. Reference should be to Example 3.4.1 and Example 4.2.3 not 3.4.4 and 4.2.4.

Page 75 Line 2 of Example. Reference should be to Example 3.4.1 not 3.4.4.

Page 77 Line -5. Replace 3.675 by 3.508.

Page 77. When written in full, the denominator in ssc/mse is

$$\frac{ssc}{msE} = \frac{\left[\frac{1}{3}(\bar{y}_{1.} + \bar{y}_{4.} + \bar{y}_{7.}) - \frac{1}{4}(\bar{y}_{2.} + \bar{y}_{3.} + \bar{y}_{5.} + \bar{y}_{6.})\right]^2}{msE\left[\frac{(\frac{1}{3})^2}{3} + \frac{(\frac{1}{3})^2}{3} + \frac{(\frac{1}{3})^2}{3} + \frac{(-\frac{1}{4})^2}{3} + \frac{(-\frac{1}{4})^2}{3} + \frac{(-\frac{1}{4})^2}{3} + \frac{(-\frac{1}{4})^2}{3}\right]} > F_{1,14,\alpha} \,.$$

Page 84 Line 5. Reference should be to Example 4.4.1 not 4.4.2.

Page 84 Line 7. Reference should be to Example 4.4.1 not 4.4.2.

Page 85 line 5. Change "intervals that" to "intervals for treatment contrasts that".

Page 88. The comments on the one-sided bounds are wrong. Below (4.4.29), it should say, "If the right hand side of (4.4.29) is positive, we infer that the ith experimental treatment gives a larger response than the control." Also, below (4.4.30), it should say "If the right-hand side is negative, we infer that the ith experimental treatment gives a smaller response than the control."

Pages 94–95. Switch order of "Contrast" and "estimate" statements in Table 4.2 to match the output in Table 4.3. Correspondingly change line numbers in Table 4.2 and on lines -1 of page 94 and -6 of page 95. (SAS output automatically lists output of "contrast" statements before output of "estimate" statements regardless of their order in the SAS program.)

Pages 96–97. Change "upper" to "lower" on page 96 line -3 and "lower" to "upper" on page 97 line 1.

Page 98. The one-sided alternative hypothesis should read "$H_A : \ \tau_0 \ - \ (\tau_1 + \tau_2 + \tau_3)/3 > 0$"
(or, "$H_A : \ (\tau_1 + \tau_2 + \tau_3)/3 \ - \ \tau_0 < 0$")

Page 100 Question 11 change wording. Replace "repeat" by " conduct an experiment similar to".

Chapter 5

Page 105. In the 4th last line, change "Example 5.2.2" to "Figure 5.1".

Chapter 6

Page 135. In line 9 of the Introduction, remove "a" from "...the a 2-digit code..."

Page 136. Line 14 of Section 6.2.1 should refer to "Page 12" not "Page 7".

Page 148, line 17. "Using (6.4.17)" should read "Using (6.4.16)".

Page 150. The α level is in error. Also, the critical coefficient should be called w_B. So, above Figure 6.4, it should say, "...$w = w_B = t_{(18-6),0.005} = 3.055$, giving

$$
\begin{aligned}
\alpha_2^* - \alpha_1^* \ &\in \ \left(\overline{y}_{2..} - \overline{y}_{1..} \pm w_B \sqrt{msE \ (1/br + 1/br)} \right) \\
&= \ 0.0723 \pm (3.055)\sqrt{0.000289(2/9)} \ = \ (0.0478, 0.0968) \ ."
\end{aligned}
$$

Page 151. Line 2 should read, "...between 0.0478 and 0.0968 seconds faster..."

Page 151. Line 7 reference should be to "Example 6.4.4", not "Example 6.4.3".

Page 151, Example 6.4.4, line 8, change "treatment combinations" to "levels of either treatment factor, using $\alpha = 0.05$.

Page 152. The third equation should have d_{ij}^2, not d_{ij}

Page 152. The third Tukey confidence interval is for $\beta_3^* - \beta_2^*$, not $\beta_1^* - \beta_3^*$, so $\beta_3^* - \beta_2^* \in (121.34, \ 755.86)$

Page 154. The last display should contain y_{ijt}^2 instead of y_{ijt} to read

$$
ssE = \sum_i \sum_j \sum_t y_{ijt}^2 - \sum_i \sum_j y_{ij.}^2/r.
$$

Page 156. Line 5. Alternative hypothesis is H_A^A not H_0^A.

Page 168. In the first line of Section 6.6, change "In Chapter 3,..." to "In Chapters 3 and 4,..."

Page 170. Last line. Reference should be to Example 6.3.1 not 6.3.2.

Page 186. Problem 11. In line 2, change "treatment combinations" to "levels of either treatment factor". In line 3, change "probability 0.9" to "probability 0.9 for $\alpha = 0.05$".

Page 191. Table 6.24. Table caption should say "Data for water boiling experiment, in minutes. (Order of observations is given in parentheses)."

Page 191. Problem 21d. Replace "...this observation." with "...this observation, but do the test in part (c) for the linear contrast only. (The formula for the linear contrast coefficients is given in (4.2.4) on page 71.)"

Chapter 7

Page 232–233 Line -3. For Exercise 5, change the 3rd last line to be, "... in Table 7.18. The error mean square was calculated to be 6.598 with 36 degrees of freedom."

Page 234. In Exercise 7, in the line above part (a), change "n" to "in".

Page 237. In Exercise 10d, delete " at least".

Page 241. Question 15c. Change "$\times 100$" to "$\times 1000$".

Page 288, lines 5–8. The corresponding six (not four) confidence intervals also include:

$$
\tau_4 - \tau_1 \in (-3.936, 3.794), \quad \tau_2 - \tau_3 \in (-3.573, 4.181)
$$

Chapter 9

Page 279. In lines 1–2, interchange "$\mu + \tau_i$" and "$\mu^* + \tau_i$". Also, insert the following before section 9.2.1: "Henceforth, we dispense with the asterisk in model (9.2.2)."

Chapter 10

Page 300, Line 6 of Example 10.3.2. Interchange 50% and 100% to read " Two levels of capacity were selected, 100% and 50%. "

Page 300, Line 6 of Example 10.3.2. Change period to comma to read "...combinations in total, which..."

Page 300, Lines 8,9 of Example 10.3.2. Interchange 50% and 100% so that the display reads

$$(100\%, \text{Brand } 1) = 1 \quad (100\%, \text{Brand } 2) = 2 \quad (100\%, \text{Brand } 3) = 3$$
$$(50\%, \text{Brand } 1) = 4 \quad (50\%, \text{Brand } 2) = 5 \quad (50\%, \text{Brand } 3) = 6$$

Page 308. Below the display calculating "msd", the following changes need to be made.

treatment 1 should read "ordinary flyer, 1.69 twist".

treatment 2 should read "ordinary flyer, 1.78 twist".

treatment 6 should read "special flyer, 1.78 twist".

Page 309. In Figure 10.3, change "$\overline{y}_{hi.}$" to "$\overline{y}_{.i}$".

Page 311. In Example 10.6.1, the reference in line 2 should be to "Example 10.3.2, page 300" not to "Ex 10.3.4 page 311."

Page 311, Lines 4,5 of Example 10.6.1. Interchange 50% and 100% so that the display reads

$$(100\%, \text{Brand } 1) = 1 \quad (100\%, \text{Brand } 2) = 2 \quad (100\%, \text{Brand } 3) = 3$$
$$(50\%, \text{Brand } 1) = 4 \quad (50\%, \text{Brand } 2) = 5 \quad (50\%, \text{Brand } 3) = 6$$

Page 312, Lines 5, 6 below table. Interchange 50% and 100% so that it reads "Consequently, Figure 10.4 suggests that treatments 1 and 2 are better than treatment 3 at 100% capacity. These treatments correspond to Brands 1 and 2 which are the more expensive brands. The position is less clear for 50% capacity. These contrasts will be examined in detail in Example 10.6.2."

Page 313. Line 7 should be $w_T = q_{v,n-v-b+1,\alpha}/\sqrt{2}$

Page 322. On page 322 at the end first paragraph (in line 4), insert "(See Table 10.16.)". At the end of the second paragraph (in the 7th last line), insert "(See Table 10.17.)".

Page 325. Qu3. In line 2 of the question the value of twist should be 1.69, not 1.63.

Page 330, line 4. Change "...hand, and the one..." to '...hand, and one..."

Page 330. Qu11. Change factor levels in Table 10.24 from 0, 1, 2 to 1, 2, 3, consistent with experiment description.

Page 332. Qu13. In last line, change "Sample fraction" to "Sampling fraction".

Page 335. Table 10.28. Change last entry from "36)" to "(36)".

Page 336. Table 10.29. Delete the heading "(order)" in three places.

Chapter 11

Page 344. Line 2, Reference to "Example 11.2.2" should be "Example 11.2.1"

Page 359. Line 5, upper limit on first sum is 9, not 8. Line 7, upper limit on both sums is 9, not 8.

Page 371, line 10. The upper limit on both sums is d, not v.

Page 374. Line 4 below table. "Section 6.8, page 175" should be "Section 6.8.1, page 177".

Page 374. Line 10 is missing. Lines 9–10 should be, "Partial output is shown in Table 11.18."

Page 380, exercise 9. Change the treatment factor levels from 0,1,2,3 to 1,2,3,4, consistent with Table 11.23.

Page 382. In exercise 12(b), change "$\overline{y}_{i.} - \overline{y}_{p.}$" to "$\overline{y}_{.i} - \overline{y}_{.p}$"

Chapter 12

Page 392, para 3, line 4. Change " but allows" to "but may allow".

Page 393. In the paragraph above Example 12.2.1, the second sentence should be as follows. "Treatment 1, for example, appears in one block with each of treatments 3 and 4, in two blocks with 2 and 7, and not at all with treatments 5, 6, or 8."

Pages 404–405. The simultaneous 95% confidence intervals in Example 12.5.2 should be as follows.

$$\begin{aligned} \tau_3 - \tau_1 &\in (27.500 \pm 16.743) = (10.58, 44.24), \\ \tau_2 - \tau_1 &\in (12.333 \pm 16.743) = (-4.41, 29.08), \\ \tau_3 - \tau_2 &\in (15.167 \pm 16.743) = (-1.58, 31.91). \end{aligned}$$

Page 410, second model. Delete extra "+"

Page 410, Section 12.9, last line. Change "it would be possible" to "it may be possible".

Page 419. Augment the Table 12.15 caption to include, "—data are 'true number' minus 'guessed number' "

Chapter 13

Page 422. The fifth line of section 13.2.1 should read, "A factorial experiment is called *symmetric* if all factors..."

Page 426. Line -4 and -5. Switch +1 and -1. (In other words, it should be "... +1 appear in Block I..." and "... −1 appear in Block II...".)

Page 431. The bottom section of Table 13.7 should be as follows.

Block	Contrast Coefficients $(ABCD, ABC)$	Treatment Combinations			
I	$(-1, -1)$	0001	0111	1011	1101
II	$(-1, \ 1)$	0010	0100	1000	1110
III	$(\ 1, -1)$	0000	0110	1010	1100
IV	$(\ 1, \ 1)$	0011	0101	1001	1111

Also, change the second paragraph below Table 13.7 to say that, "...the treatment combinations in Block I and Block IV have the fourth digit equal to 1, and all of those in Blocks II and III have the fourth digit equal to 0."

Page 436, Example 13.4.1. L_3 in the display should be $L_3 = a_1 + a_4 + a_6$ to match the ADF contrast selected.

Page 443. Line -8. replace "repeating" by "using".

Page 448, line -4. Change 2667.04 to 2667.04/56,546.07, which is 0.0472—less than the F value.

Page 451, Table 13.18, change "110" to "010" in block X.

Page 474, Example 14.4.2, line 6, change "two blocks of the design d_2" to "three blocks of the design d_2".

Chapter 15

Page 485. Half way down the page should read: This "$A = BC$" contrast is equal to...

$$= [-\overline{\tau}_{0..} + \overline{\tau}_{1..}] + \frac{1}{2}[\overline{\tau}_{.00} - \overline{\tau}_{.01} - \overline{\tau}_{.10} + \overline{\tau}_{.11}].$$

Page 486. Half way down the page should read: The estimable A contrast in the three-way model is of the form...

$$= [-\overline{\tau}_{0..} + \overline{\tau}_{1..}] - \frac{1}{2}[\overline{\tau}_{.00} - \overline{\tau}_{.01} - \overline{\tau}_{.10} + \overline{\tau}_{.11}],$$

Page 503. Example 15.5.1. Label this "Flour experiment number 3", not "Flour experiment"

Page 504, Table 15.17, change end of table heading from "and experiment" to "for flour experiment number 3"

Page 507. Lines 7 and 8. Replace "$p = 8$ rows and $p - 1 = 7$ columns" by "$2^p = 8$ rows and $2^p - 1 = 7$ columns".

Page 510, three lines above Table 15.26. Should read "The contrast estimates for factors A and H are considerably larger in absolute value".

Page 511. In Table 15.26, the levels of factor A—namely, the first column of digits in the table—should be eight zeroes followed by eight ones, not 16 zeroes.

Page 517. In line 7, change "Under designled experimental conditions, it was possible..." to "For the experiment, it was possible..."

Page 525. In the SAS program, add the code line below to each `PROC GLM` call, in view of comments on page 526.

```
LSMEANS A B C D E F G;
```

Page 530, exercise 3. Lines 6–7 should read, "The data for the first replicate of the original experiment were given in Table 15.46 (page 468) and the first block of data is reproduced in Table 15.46." The last sentence should start, "Analyze the data of Block I..."

Page 535 Ex 8. The design in Table 15.50 should be as follows.

Block	A B C D E F G H J K L M N	Repl. I	Repl. II
II	0 0 0 0 1 1 1 1 1 0 0 0 0	1511	1506
I	1 0 0 0 0 0 1 1 0 1 1 0 0	375	370
I	0 1 0 0 1 1 0 0 0 1 0 1 0	392	392
II	1 1 0 0 0 0 0 0 1 0 1 1 0	523	520
I	0 0 1 0 0 1 0 1 0 0 1 1 1	481	479
II	1 0 1 0 1 0 0 1 1 1 0 1 1	2238	2230
II	0 1 1 0 0 1 1 0 1 1 1 0 1	550	551
I	1 1 1 0 1 0 1 0 0 0 0 0 1	546	542
I	0 0 0 1 1 0 1 0 1 1 1 1 1	369	367
II	1 0 0 1 0 1 1 0 0 0 0 1 1	2242	2243
II	0 1 0 1 1 0 0 1 0 0 1 0 1	584	592
I	1 1 0 1 0 1 0 1 1 1 0 0 1	446	447
II	0 0 1 1 0 0 0 0 0 1 0 0 0	1776	1782
I	1 0 1 1 1 1 0 0 1 0 1 0 0	1053	1059
I	0 1 1 1 0 0 1 1 1 0 0 1 0	462	463
II	1 1 1 1 1 1 1 1 0 1 1 1 0	582	582

Page 538, exercise 10, should read as follows. "The orthogonal array in Table 15.23 was selected with columns 1–6 labeled A, B, D, C, E, F. Columns 4–6 were multiplied by -1. One degree of freedom (corresponding to column 7) is available to measure σ^2 or one of the two-factor interactions."

Chapter 16

Page 547. Delete the last sentence on the page—namely, "The levels at which the observations were taken are marked on the plot."

Page 548, line -6. Change "(as illustrated in Figure 16.1)." to "(as suggested by Figure 16.1)."

Page 555. Change n to be n_d under (16.2.8).

Page 559. The reference at end of Example 16.2.4 should be to Example 16.3.1.

Page 563, Example 16.3.1. The experimenters chose α to be approximately equal to $\sqrt{2}$, but not exactly. In Table 16.9, the entries $\sqrt{2}$ for "Anode-cathode separation" (Factor A) should be 1.5, and the entries $\sqrt{2}$ for "Current density" (Factor B) should be 1.4.

Page 565, Example 16.3.2. In line 2, change "for these data" to "for the coded data". Also, delete the sentence "The same analysis...levels" in lines 3–4.

Page 566. In lines 2 and 3, the center points are 4.32 and 4.25, which have sample variance 0.00245. This gives $F = 19.299$ for the lack-of-fit test. This is still not significant, with $P > 0.10$. The text at the top of page 566 should say:

"Before settling on a final model, we should check the lack of fit of the second-order model. The only replication consisted of two center-point observations with values 4.32 and 4.25. The sample variance of these two observations is $s_0^2 = 0.00245$, so $ssPE = 0.00245$ with one degree of freedom. From the analysis of variance table, Table 16.11, we see that $ssE = 0.1443$

with 4 degrees of freedom. So,

$$ssLOF = ssE - ssPE = 0.1443 - 0.00245 = 0.14185$$

with $4 - 1 = 3$ degrees of freedom for lack of fit. There is significant lack of fit of the second-order model if

$$msLOF/msPE > F_{3,1,\alpha}\,,$$

for appropriate significance level α. Here,

$$msLOF/msPE = (0.14185/3)/(0.00245/1) = 19.299\,,$$

which is less than $F_{3,1,0.10} = 53.6$, so there is no significant lack of fit of the second-order model, and the model fitted in Example 16.3.2, page 563, should be a reasonable approximation to the true surface in the local region under study ($9.5 \le x_A \le 11.5$; $31 \le x_B \le 41$). □"

Page 573 PAH expt. Reference to Table 16.19 should be Page 581 not Page 582.

Pages 580–584. Delete the parenthetical remark "(see page 58#)" under each table.

Chapter 17

Page 604, line -2. Reference should be to Examples 17.3.1 and 17.3.2, not to Examples 17.3.3 and 17.3.4.

Page 606, line 2 of Example 17.3.4. Reference should be to Examples 17.3.1 and 17.3.2, not to Examples 17.3.3 and 17.3.4.

Page 609, Example 17.4.1, line 2. Should be H_A, not H_0.

Page 616. Line 13 should read

$$u = (msB - ms(AB) - ms(BD) + msE)/adr$$

so that the signs match those of the estimator U.

Page 623. Equation (17.7.25) should have Y_{ijkt}, not Y_{ijt}

Page 626. Lines 9, 11 and 19 should be as follows, respectively.

$$\widehat{\alpha}_i^* - \widehat{\alpha}_p^* = \left(\widehat{\alpha}_i + \widehat{(\alpha\beta)}_{i.}\right) - \left(\widehat{\alpha}_p - \widehat{(\alpha\beta)}_{p.}\right) = \overline{y}_{i...} - \overline{y}_{p...}$$

$$\widehat{\beta}_j^* - \widehat{\beta}_u^* = \left(\widehat{\beta}_j + \widehat{(\alpha\beta)}_{.j}\right) - \left(\widehat{\beta}_u + \widehat{(\alpha\beta)}_{.u}\right) = \overline{y}_{.j..} - \overline{y}_{.u..}\,.$$

$$\mathrm{Var}(Y_{ijkt}) = \sigma_D^2 + \sigma_{BD}^2 + \sigma^2 \quad \text{and} \quad \mathrm{Var}(\overline{Y}_{.j..}) = \frac{\sigma_D^2}{d} + \frac{\sigma_{BD}^2}{d} + \frac{\sigma^2}{adr}\,.$$

Page 631. Table 17.11 should have $mse = 802.57$.

Page 632. In line 3 of section 17.10.1, change "$r = 11$" to "$r = 4$"

Pages 633–634. The following 2 changes are needed to generate Figure 17.5, which is a plot of the treatment averages rather than the predicted values.

First, delete "—namely, the standardized predicted values—" from the sentence ending page 633 and starting page 634.

Secondly, replace Table 17.12 on page 634 with the following.

```
 PROC SORT;  BY BALE;
 PROC MEANS NOPRINT;  BY BALE;
   VAR CONTENT;
   OUTPUT OUT=WOOL2 MEAN=AVCONT;
 PROC STANDARD STD=1.0 MEAN=0.0;
   VAR AVCONT;
 PROC RANK NORMAL=BLOM;
```

```
   VAR AVCONT;
   RANKS NSCORE;
 PROC PLOT;
   PLOT AVCONT*NSCORE=BALE / VPOS=15 HPOS=40 HREF=0 VREF=0;
```

Page 638 line 3. Change "(Example 17.3.3, page 600)" with "(Example 17.3.1, page 600)". Also, Figure 17.6 is not quite correct, as the model fit included the linear order covariate and should not. In either case, the quadratic pattern is apparent. The SAS program ice.sas has been corrected on the web.

Page 639. Qu1 line2. Insert after "concentrations" the units as follows "concentrations (mg/ml)".

Page 641. The following text is missing from the bottom of the page.

6. **Golf ball experiment** (Tim Kelaghan, 1995)
An experiment was planned by Tim Kelaghan in 1995 to examine whether different brands of golf balls travel on average the same distances when hit by amateur golfers. The experiment was planned with a specific selection of $v = 3$ golf balls and some

Page 642 Delete Question 6b.

Page 643 Qu 8. The references in line 2 should be "Examples 17.3.2 – 17.3.4 and 17.4.1", not "Examples 17.3.2 – 17.3.5 and 17.4.1".

Include a page reference, i.e. "In Section 17.10, page 638, a new model...".

Page 643 Qu 8c. Should read "Redo the analyses of Examples 17.3.3 and 17.3.4 for the new model...".

Chapter 18

Page 653. The model indices should also include "$u = 1, 2$;"

Page 660 line 6. Replace "...the ith method of analysis and with the jth laboratory,..." with "... the ith method of analysis, the uth soil location with the jth laboratory,...".

Page 661. Table 18.5 In the bottom half of the table, correct the second term of $ssAD$ to sum over i, not j, so that we have:
$$ssAD = 24\Sigma_i\Sigma_u\overline{y}_{i..u.}^2 - 72\Sigma_i\overline{y}_{i...}^2 - 48\Sigma_u\overline{y}_{...u.}^2 + 144\overline{y}_{.....}^2$$

Page 664. In the second call of GLM, replace the `LSMEANS` statement with the SAS code below. The error term for comparing levels of SETTING is still not quite correct, but one would need to use `PROC MIXED` for example to do better.

```
LSMEANS TESTING / PDFIFF=ALL CL ADJUST=TUKEY ALPHA=0.05;
* The following should be approximately correct;
LSMEANS SETTING / PDFIFF=ALL CL ADJUST=TUKEY ALPHA=0.05 E=REGUL(SETTING);
```

Page 665, last 4 lines. This is an 80% confidence interval, not 90%, and both F critical values in the second last line should have generic degrees of freedom ν_1 and ν_2, not just the first critical value.

Page 669 Qu 4c Replace the null hypothesis

$$H_0 : \{\text{no differences in yield strength of the titanium alloy}$$
$$\text{can be attributed to the two test specimens}\}$$

with the null hypothesis

$$H_0 : \{\text{no differences in yield strength of the titanium alloy}$$
$$\text{can be attributed to the four vendors}\} .$$

Page 670. Qu 6. Line 6 should say "sliced from".

Page 670 Qu 6c. Should read "Using the data in Table 18.11...".

Page 671, Qu 8. "Erythrocite" should be spelled as "erythrocyte" throughout (including the experiment index).

Line 7. Replace "selected at random from each trough and divided between two counting chambers. The erythrocite counts were then measured." with the following: "selected at random from each trough

and the erythrocyte count from the blood of each fish was measured in two different counting chambers, giving two measurements per fish".

In the model, the variances should be $\sigma^2_{B(A)}$ and $\sigma^2_{C(AB)}$, not σ^2_B and $\sigma^2_{C(A)}$. Also, modify limits on k and t to $t = 1, 2; \quad k = 1, \ldots, 5$, and delete the subscript l from the model.

Page 672 line -2. Add distribution for $(\alpha C)_{ik(j)}$ so that it reads

$$\epsilon_{ijkt} \sim N(0, \sigma^2); \quad C_{k(j)} \sim N(0, \sigma^2_{C(B)}); \quad (\alpha C)_{ik(j)} \sim N(0, \sigma^2_{AC(B)});$$
$$\epsilon_{ijkt}\text{'s}, C_{k(j)}\text{'s, and } (\alpha C)_{ik(j)}\text{'s are all mutually independent,}$$

Tables

Page 722. The footnote of Table A.10 should begin, "Values $w_{D2}\ldots$

Index of Experiments

Page 733. The "breathalyzer" experiment could have entries for pages 297 and 340, though there's no raw data provided.

Page 733. The "cotton spinning" experiment should have an entry for page 306.

Page 733. "erythrocite" should be spelled as "erythrocyte".

Page 733. Flour. Split the listings: Flour experiment 1 page 536. Flour experiment 3 page 503, 531.

Page 734. The "resting metabolic rate" experiment should be listed as page 302, not 325.

Page 734. The "soap" experiment should have an entry for page 58.

Index of Subjects

Page 737. At page top left, "bf E" should be "**E**".