

## Corrections to *Probability and Statistics* (Third Edition)

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If you find errors in the book not listed here or if you wish to offer comments on the book, send them by email to mark “at” stat.cmu.edu.

### Preface

- p. xv: I forgot to thank Valerie Ventura, who read an early draft of Section 11.5. (10/22/01)

### Chapter 1

*Section 1.1*

*Section 1.2*

*Section 1.3*

*Section 1.4*

*Section 1.5*

*Section 1.6*

*Section 1.7*

*Section 1.8*

*Section 1.9*

*Section 1.10*

- p. 41, Theorem 1.10.2, line 2: “ $\sum_{i=1}^n$ ” should be “ $\sum_{i=1}^n$ ”. (7/9/02)

*Section 1.11*

*Section 1.12*

### Chapter 2

*Section 2.1*

- p. 52, Theorem 2.1.1: Remove the words “ $\Pr(B) > 0$  and” from the statement. (6/13/02)
- p. 53, Theorem 2.1.2: Also assume that  $\Pr(B) > 0$ . (10/12/01)

*Section 2.2*

- p. 59, line –13: “exactly two nondefectives” should read “exactly two defectives”. (9/5/02)

### *Section 2.3*

- p. 76, line 9: “Example 2.3.2” should read “Example 2.3.10”. (10/18/02)
- p. 76, in Example 2.3.11, the third line of the table should read  
Prior prob.   0.00   0.19   0.19   0.17   0.14   0.11   0.09   0.06   0.04   0.01   0.00  
(9/8/03)
- p. 76, Figure 2.4 caption line 2: “25” should read “40” (10/18/02)
- p. 78, Exercise 18: Assume that  $\Pr(B) = 0.4$ . (10/12/01)

### *Section 2.4*

### *Section 2.5*

### *Section 2.6*

## **Chapter 3**

### *Section 3.1*

- p. 101 On line 5 of the NOTE: “ $X_1(s) = 100i_1 = 10i_2 + i_3$ ” should be “ $X_1(s) = 100i_1 + 10i_2 + i_3$ ”. (5/14/07)

### *Section 3.2*

### *Section 3.3*

### *Section 3.4*

### *Section 3.5*

- p. 136 Exercise 8: add the condition  $y \geq 0$  to the first branch of the definition of  $f(x, y)$ . (2/15/02)

### *Section 3.6*

### *Section 3.7*

- p. 153, equation (3.7.10): “for  $x > 0$ ” should read “for  $z > 0$ ” (10/22/04)
- p. 154, second displayed equation: “ $\frac{2}{9}$ ” should read “ $\frac{4}{9}$ ”. (12/28/09)
- p. 155, last line: “ $g(x_3|z)g(x_3|z)g(x_4|z)$ ” should read “ $g(x_3|z)g(x_4|z)g(x_5|z)$ ” (10/22/07)
- p. 157 Exercise 3 line 5: “for  $x_i > 1$ ” should read “for  $x_i > 0$ ” (1/25/02)

### *Section 3.8*

- p. 164, Exercise 5, in the displayed equation, “ $G$ ” should be “ $g$ ” (2/5/07)

- p. 164, Exercise 12, line 3: “page 114” should read “page 115” (10/12/01)
- p. 164, Exercise 14: Assume that  $c > 0$ . (1/28/02)

*Section 3.9*

- p. 176, Exercise 18 line2: “for  $0 < x < 1$ ” should read “for  $0 < x < y$ ” (10/12/01)

*Section 3.10*

## Chapter 4

*Section 4.1*

- p. 189 Exercise 14(b) line 3: “loses  $4.16x - 84$ ” should read “loses  $|4.16x - 84|$ ” (10/12/01)

*Section 4.2*

*Section 4.3*

*Section 4.4*

*Section 4.5*

*Section 4.6*

- p. 221, Exercise 8 in displayed equation: “ $\sum_{i=1}^m a_i, X_i$ ” should read “ $\sum_{i=1}^m a_i X_i$ ”. (4/7/03)

*Section 4.7*

- p. 227, Figure 4.8: In the legend, the solid line should be labelled “Marginal” and the dotted line should be labelled “Conditional”. (10/15/01)

*Section 4.8*

- p. 232, last line of Example 4.8.2: “ $0.02/0.005^2$ ” should read “ $1/(0.02 \times 0.005^2)$ ” (5/15/03)

*Section 4.9*

*Section 4.10*

## Chapter 5

*Section 5.1*

*Section 5.2*

*Section 5.3*

*Section 5.4*

*Section 5.5*

*Section 5.6*

- p. 273, Example 5.6.4 line 2: “interested finding” should read “interested in finding” (6/25/03)
- p. 277, Example 5.6.7 line 10: “Then then” should read “Then” (2/25/03)

*Section 5.7*

- p. 284, line 13: “ $\Phi^{-1}(0.01)^2$ ” should read “ $\Phi^{-1}(0.99)^2$ ” (6/4/03)
- p. 284, line 15: “no more that 1/4” should read “no more than 1/4” (2/25/03)
- p. 291, Exercise 14: In both parts (a) and (b), the lower limit of summation should be “ $i = 1$ ” rather than “ $i - 1$ ”. (10/12/01)

*Section 5.8*

*Section 5.9*

- p. 302, Exercise 16, displayed equation (numerator): “ $x_0^a$ ” should read “ $x_0^\alpha$ ” (4/7/03)

*Section 5.10*

- p. 304, line 8: “Eq. (5.10.2)” should refer to the unnumbered displayed equation in lines 2 and 3 of the page. (11/1/07)

*Section 5.11*

*Section 5.12*

- p. 315, Eq. (5.12.6): “ $E(X_2|X_1)$ ” should read “ $E(X_2|x_1)$ ”. (10/22/01)
- p. 319, Exercise 4, line 4: “his” should be “her”. (11/17/02)

*Section 5.13*

## **Chapter 6**

*Section 6.1*

*Section 6.2*

*Section 6.3*

- p. 341, Example 6.3.5, line 9: “distribution of  $\mu$ ” should read “distribution of  $\theta$ ” (2/25/03)
- p. 342, line 1: “ $1 - \Phi(1.23) = 0.1093$ ” should read “ $1 - \Phi(1.12) = 0.1314$ ” (4/7/03)

*Section 6.4*

- p. 351, Example 6.4.5, line 7: “Eq. (3.6.1)” should read “Eq. (6.3.1)” (2/21/03)

*Section 6.5*

- p. 361, last line: “Exercise 6” should read “Exercise 10” (10/29/07)
- p. 363, in the hint for Exercise 10: “when the distribution is specified in Exercise 1” should read “as in Theorem 4.5.1” (7/17/09)

*Section 6.6*

*Section 6.7*

*Section 6.8*

*Section 6.9*

- p. 385, line 7: “(6.9.3)” should read “(6.9.4)”. (8/5/09)

*Section 6.10*

## **Chapter 7**

*Section 7.1*

*Section 7.2*

*Section 7.3*

*Section 7.4*

*Section 7.5*

*Section 7.6*

- p. 420, Eq. (7.6.8): “ $\xi_1(\tau z + \mu_0|\tau)$ ” should read “ $\xi_1((\lambda_0\tau)^{-1/2}z + \mu_0|\tau)$ ”. (4/7/03)
- p. 426, line 8: “probability  $\alpha$ ” should read “probability  $1 - \alpha$ ”. (4/7/03)

*Section 7.7*

*Section 7.8*

*Section 7.9*

- pp. 446–447, Exercises 14–23: Shortly before the text went to press, the Exercises 13(b) through 22 got renumbered as 14–23. That is, Exercise 14 is supposed to be Exercise 13(b), and 15–23 are supposed to be 14–22. The answers on page 793 that are labeled 15 and 21 are now answers to Exercises 16 and 22. I don’t know how this renumbering happened.  
(10/12/01)

## **Chapter 8**

*Section 8.1*

- p. 453, Example 8.1.3, line 6: “Example 6.5.15” should read “Example 6.5.5” (10/9/02)
- p. 462 Exercise 11: “ $\delta_c$ ” should read “ $\delta$ ” at the ends of parts b and c.  
(4/7/03)

*Section 8.2*

*Section 8.3*

*Section 8.4*

*Section 8.5*

- p. 486, Figure 8.8 caption: first “ $\Omega$ ” should read “ $\Omega_1$ ”. (7/24/09)
- p. 492, line 26: “ $c = T_{n-1}(1 - \alpha_0/2)$ ” should read “ $c = T_{n-1}^{-1}(1 - \alpha_0/2)$ ”.  
(2/8/08)

*Section 8.6*

- p. 500, line –8: “then  $\psi =$ ” should read “then  $|\psi| =$ ”. (4/7/03)

*Section 8.7*

*Section 8.8*

- p. 518, last line of Example 8.8.1: “ $\Phi^{-1}(w_1/(w_0 + w_1))$ ” should read “ $-\Phi^{-1}(w_1/(w_0 + w_1))$ ” (7/16/09)
- p. 521, 2 and 4 lines after (8.8.16): In both places, “ $T_{n-1}^{-1}(1 - \alpha_0)$ ” should read “ $-T_{n-1}^{-1}(1 - \alpha_0)$ ” (4/7/03)

*Section 8.9*

*Section 8.10*

## Chapter 9

*Section 9.1*

*Section 9.2*

*Section 9.3*

*Section 9.4*

- p. 559, line 5 of Example 9.4.1: “quantile of” should read “quantile of the” (3/20/08)

*Section 9.5*

*Section 9.6*

*Section 9.7*

- p. 577, last displayed equation: “ $f^2(0)$ ” should be “ $f^2(\mu)$ ”. (1/5/10)

*Section 9.8*

- p. 588, second line after (9.8.1): “ $Y_1 = 0$ ” should be “ $Y_i = 0$ ”. (1/6/10)
- p. 589, second line of Example 9.8.1: “intereted” should be “interested”. (3/26/08)
- p. 591, first line of text: “signed ranks test” should read “ranks test”. (4/7/03)
- p. 593, Eq. (9.8.6): The correct formula is

$$\begin{aligned}\text{Var}(S) = mn & \left( \Pr(X_1 \geq Y_1) - (m+n-1) \Pr(X_1 \geq Y_1)^2 \right. \\ & \left. + (n-1) \Pr(X_1 \geq Y_1, X_1 \geq Y_2) + (m-1) \Pr(X_1 \geq Y_1, X_2 \geq Y_1) \right).\end{aligned}$$

(11/26/01)

- p. 595, Exercise 15: There are a few errors in the statement of the problem. The corrected exercise is given here:

**15.** Consider again the conditions of Exercise 1. This time, let  $D_i = X_i - Y_i$ . Wilcoxon (1945) developed the following test of the hypotheses (9.8.7). Order the absolute values  $|D_1|, \dots, |D_n|$  from smallest to largest, and assign ranks from 1 to  $n$  to the values. Then  $S_W$  is set equal to the sum of all the ranks of those  $|D_i|$  such that  $D_i > 0$ . If the distribution of  $D_i$  is symmetric around 0, then the mean and variance of  $S_W$  are

$$E(S_W) = \frac{n(n+1)}{4}, \tag{9.8.8}$$

$$\text{Var}(S_W) = \frac{n(n+1)(2n+1)}{24}. \tag{9.8.9}$$

The test rejects  $H_0$  if  $S_W \geq c$ , where  $c$  is chosen to make the test have level of significance  $\alpha_0$ . This test is called the *Wilcoxon signed ranks test*. If  $n$  is large, a normal distribution approximation allows us to use  $c = E(S_W) + \Phi^{-1}(1 - \alpha_0)\text{Var}(S_W)^{1/2}$ .

- a. Let  $W_i = 1$  if the  $|D_j|$  that gets rank  $i$  has  $D_j > 0$  and  $W_i = 0$  if not. Show that  $S_W = \sum_{i=1}^n iW_i$ .
- b. Prove that  $E(S_W)$  is as stated in Eq. (9.8.8) under the assumption that the distribution of  $D_i$  is symmetric around 0. *Hint:* You may wish to use Eq. (4.7.13).
- c. Prove that  $\text{Var}(S_W)$  is as stated in Eq. (9.8.9) under the assumption that the distribution of  $D_i$  is symmetric around 0. *Hint:* You may wish to use Eq. (4.7.14).

(11/26/01)

#### Section 9.9

### Chapter 10

#### Section 10.1

- p. 606, second line after (10.1.12): “ $\partial Q/\partial B_j$ ” should read “ $\partial Q/\partial \beta_j$ ”. (4/7/03)

#### Section 10.2

- p. 610, in (10.2.1): “ $x_2$ ” should read “ $x_k$ ”. (1/29/10)
- p. 614, 3rd displayed equation: “ $\frac{202.95\sigma^2}{530.78} = 0.382\sigma^2$ ” should read “ $-\frac{202.95\sigma^2}{530.78} = -0.382\sigma^2$ ”. (4/7/03)
- p. 615, Example 10.2.3, line 4: “ $\hat{\beta}_0 = -81.049$ ” should read “ $\hat{\beta}_0 = -81.06$ ” (4/7/03)

#### Section 10.3

- p. 619, first line after (10.3.2): “ $\sum_{j=1} a_{1j}a_{2j}$ ” should read “ $\sum_{j=1}^n a_{1j}a_{2j}$ ”. (4/7/03)
- p. 633, last line of (10.3.27): “ $y_1$ ” should read “ $y_i$ ”. (1/29/10)
- p. 634, Eq. (10.3.28), end of first line: “ $\beta_{\beta_1}^*$ ” should read “ $\beta_1^*$ ”. (4/7/03)



- p. 638, Exercise 22: The problem should have asked for the regression of logarithm of 1980 price on the logarithm of 1970 price. It can be solved either as stated here or as stated in the text, but the regression on logarithm of 1970 price makes more sense. (12/14/01)

#### Section 10.4

- p. 639, end of second to last displayed equation:  $-\frac{n\bar{x}_n s_x^2}{\tau \sum_{i=1}^n x_i^2}$  should read  $-\frac{\tau n\bar{x}_n s_x^2}{\sum_{i=1}^n x_i^2}$ . (4/7/03)
- p. 640, two lines after (10.4.6):  $-\tau^2/2$  should read  $-\tau/2$ . (4/7/03)
- p. 641, first line after (10.4.7): “15 degrees of freedom” should read “14 degrees of freedom”. (4/7/03)
- p. 644, first line of text: “7.191” should read “7.181”. (4/7/03)

#### Section 10.5

- p. 650, Example 10.5.2, end of first displayed equation: “144.1” should read “172.3”. (4/7/03)
- p. 652, three lines before Example 10.5.3: “ $j = 1, \dots, n$ ” should read “ $j = 0, \dots, p-1$ ”. (4/7/03)
- p. 658, last displayed equation: “ $z_{i0}\beta_0 - \dots - z_{ip-1}\beta_{p-1}$ ” should read “ $z_{i0}\hat{\beta}_0 - \dots - z_{ip-1}\hat{\beta}_{p-1}$ ”. (4/7/03)
- p. 661, line -8: “ $z_{i0}\hat{\beta}_0 + \dots + z_{ip-1}\hat{\beta}_{p-1}$ ” should read “ $z_{i0}\beta_0 + \dots + z_{ip-1}\beta_{p-1}$ ”. (4/7/03)
- p. 662, Exercise 2, line 2: “ $S^2$  has a  $\chi^2$ ” should be “ $S^2/\sigma^2$  has a  $\chi^2$ ”. (12/16/01)

#### Section 10.6

- p. 668, line 5: “Eq. (10.6.7) has a” should read “Eq. (10.6.7), when divided by  $\sigma^2$ , has a”. (4/7/03)
- p. 672, Exercise 2, displayed equation: Both places where  $\sigma^2$  appears in a denominator should be  $\sigma$ . (4/7/03)
- p. 673, Exercise 14(a): “ $\sum_{i=1}^p \alpha_i$ ” should be “ $\sum_{i=1}^p n_i \alpha_i$ ” (12/17/01)

#### Section 10.7

- p. 680, line 6: The “typo” that had been listed here was actually correct as stated in the book. (7/9/08)

*Section 10.8*

*Section 10.9*

## Chapter 11

*Section 11.1*

- p. 702, line -5: “estimate parameter” should read “estimate a parameter” (10/12/01)
- p. 711 Exercise 1 line 9: “ $\Pr(|Z - \mu| \leq c)$ ” should read “ $\Pr(|Z - \mu| \leq \epsilon)$ ” (12/19/01)

*Section 11.2*

- p. 714, first row of last displayed equation: “ $f(\exp[(y_1^2 + y_2^2)/2])$ ,” should read “ $f(\exp[-(y_1^2 + y_2^2)/2])$ ,”. (4/7/03)
- p. 722, Example 11.2.10, last line: “is” should read “if”. (4/7/03)

*Section 11.3*

*Section 11.4*

- p. 748, last displayed equation: The equation should read

$$Y = \exp\left(\mu + \tau^{-1/2}\Phi^{-1}[U\Phi([\log(0.5) - \mu]\tau^{1/2})]\right)$$

(4/7/03)

- p. 752, column 1 line 3: “variance  $\gamma_0$ ” should read “precision  $\gamma_0$ ” (1/3/02)
- p. 752, Exercise 13(a): The “1/2” exponent should be “-1/2” in the displayed formula. (1/3/02)
- p. 752, Exercise 14: Add the text “The prior hyperparameters are  $\alpha_0 = 0.5$ ,  $\mu_0 = 0$ ,  $\lambda_0 = 1$ , and  $\beta_0 = 0.5$ .” (1/4/02)
- p. 753, Exercise 15 part a line 2: Delete the text “if  $X_{n+i} \leq c$ , then” (1/4/02)
- p. 753, Exercise 15 part b line 2: Delete the text “if  $X_{n+i} \geq c$ , then” (1/4/02)

*Section 11.5*

*Section 11.6*

- p. 767, Exercise 12 line 7: “(8.6.9)” should read “(8.6.3)” (1/6/02)
- p. 767, Exercise 13(b) line 2: “ $v\sigma$ ” should read “ $v\sigma^2$ ” (1/7/02)
- p. 767 Exercise 16: The displayed formula should read

$$L(\theta, a) = \begin{cases} 30(a - \mu) & \text{if } a \geq \mu, \\ (\mu - a)^2 & \text{if } \mu > a. \end{cases}$$

(1/7/02)

## Tables

## References

## Answers to Exercises

- p. 782, Exercise 5 in Section 1.9: “ $n_6!$ ” should be “ $n_6$ ” (7/9/02)
- p. 782, The answer to 13.(d) that appears in Section 1.10 should appear in Section 1.12. (7/9/02)
- p. 782, Exercise 11.(a) in Section 2.2: “0.25” should read “0.2617” (7/9/02)
- p. 790, line 6, answer to 29: “ $\sqrt{p}$ ” should read “ $\sqrt{\bar{X}_n}$ ”. (4/7/03)
- p. 792, Section 7.6, answer to 9: “(a)(7.084,7.948); (b)(7.031,7.969)” should read “(a)(157.8,210.1); (b)(152.6,211.8)” (4/7/03)
- p. 793, lines 3–4: The answers labeled 15 and 21 are actually answers to Exercises 16 and 22 due to the mysterious renumbering that was described above for pages 446–447. (10/12/01)
- p. 793, Section 8.1, answer to 11.(a): “ $c_1 = 1$ ” should read “ $c_1 < 0$ ”. (4/7/03)
- p. 793, Section 8.1, answer to 11.(b): “0.0956” should read “0.0994”. (4/7/03)
- p. 794, Exercises 11(a) and 11(b) in Section 8.6: Both should be “Don’t reject  $H_0$ .” (11/9/01)
- p. 795, Exercise 17 in Section 9.7: “ $[2nf(\theta_{1/4})^2]^{-1}$ ” should read “ $[4nf(\theta_{1/4})^2]^{-1}$ ”. (4/7/03)
- p. 795, Exercise 1 in Section 9.9: “(322,440)” should be “(141,175)”. (12/12/01)
- p. 799, Exercise 5 in Section 11.4 should read “Approximation = 0.2542, sim. std. err. =  $4.71 \times 10^{-4}$ .” (1/3/02)
- p. 799, Exercise 7 in Section 11.4: “825.8” should be “826.8” (1/3/02)

## Index