ERRATA

INTRODUCTION TO REGRESSION ANALYSIS

by M. Golberg and Hokwon Cho

The following is a list of known errors in the book *Introduction to Regression Analysis* for the first printing in 2004 and the second printing in 2007. These will be corrected and shown in the third printing.

The corrections of the errors have been ordered by page number. The number after the page number is the line where the error is. A negative sign means the line is counted from the bottom. Two or more numbers mean there are corrections on several lines.

I would like to thank my graduate students Denrick Bayot, Yanan Jiang, Serena Petersen, Jennifer Rolfes, and Yanxia (Tina) Zhao for pointing out some of these errors.

p 69, 5–: In the next line to Eq (3.60), change "$Cov\,(Y_i, Y_i) = 0$" to "$Cov\,(Y_i, Y_j) = 0$." The second subscript of Y_i is changed.

p 70, Eq (3.65): Change "$2Cov\left(Y_i, \hat{Y}_i\right)$" to "$2\sum_{i=1}^{n} Cov\left(Y_i, \hat{Y}_i\right)$" in two places. The summations are missing.

p 74, 11–: In deriving Eq (3.87) (the Lagrangian constraints), it would be better to read "... must be true for all β_0 and β_1, we ..." than "... must be true for all c_i, we ..."

p 74, Eq (3.91): Change "$\sum_{i=1}^{n} c_i x_i = 0$" to "$\sum_{i=1}^{n} c_i x_i = 1$."

p 83, 2: For clarity, SSR is defined through the displayed definition (formula)

$$R^2 = \frac{SSR}{SST} = \frac{\sum_{i=1}^{n}(\hat{y}_i - \overline{y})^2}{\sum_{i=1}^{n}(y_i - \overline{y})^2},$$

where SSE is the error sum of squares (or residual sum of squares, RSS), and $SSE = SST - SSR = \sum_{i=1}^{n}(y_i - \hat{y}_i)^2$.

p 83, Theorem 3.6 (iv): The displayed Eq (3.140) should read

$$\rho^2(\mathbf{x}, \mathbf{y}) = \frac{\left[\sum_{i=1}^{n}(x_i - \overline{x})(y_i - \overline{y})\right]^2}{S_{xx}S_{yy}}.$$

The numerator on the right hand side of the equation should be squared.

p 84, Eq (3.145): Change "$\sum_{i=1}^{n} x_i\hat{\varepsilon}_{ii}\hat{\beta}_1$" to "$\sum_{i=1}^{n} x_i\hat{\varepsilon}_i\hat{\beta}_1$" and change also "$\hat{\beta}_1\sum_{i=1}^{n} x_i\hat{\varepsilon}_{ii}$" to "$\hat{\beta}_1\sum_{i=1}^{n} x_i\hat{\varepsilon}_i$." The subscript of $\hat{\varepsilon}_{ii}$ is changed to $\hat{\varepsilon}_i$ in two places.

p 86, 8–: In the last paragraph, the line should read "Classically, the df associated..." A comma is inserted.

p 88, Table 3.10: Change "17.484" to "17, 484" under the Mean Squares.

p 106, Eq (3.208): Change $(n-2)$ to $(m-2)$ in the numerator of F-ratio.

p 106, Table 3.20: Change "$MS_{LOF} = \frac{SS_{LOF}}{n-2}$" to "$MS_{LOF} = \frac{SS_{LOF}}{m-2}$." The divisor in MS_{LOF} must be $m-2$, not $n-2$.

p 109, Theorem 3.9: change the second "(iii)" to "(iv)." The numbering (iii) in the theorem is repeated.

p 110, Eq (3.216): The displayed formula for the studentized residual should read

$$\hat{r}_i = \frac{\hat{\varepsilon}_i}{s\sqrt{1-[1/n+(x_i-\overline{x})^2/S_{xx}]}}.$$

In the denominator of $\hat{r}_i$, change $\{\cdots\}$ to $\sqrt{\cdots}$.

p 123, Ex 3.1 (a): Change "$\sum_{i=1\hat{\varepsilon}i}^{n} = 0$" to "$\sum_{i=1}^{n} \hat{\varepsilon}_i = 0$."

p 125, Ex 3.10: Change labels "(c)-(f)" to "(b)-(e)." The items are labeled incorrectly.

p 126, Ex 3.13 (d): In the Hint, change "$SSR \big/ \sum_{i=1}^{n} x_i^2$" to "$SSR \Big/ \sum_{i=1}^{n} (x_i - \overline{x})^2$."

Note that $\sum_{i=1}^{n} (x_i - \overline{x})^2 = S_{xx}$.

p 145, Eq (4.102): The *orthogonal projection* should be $\mathbf{y}_p = \langle \mathbf{y}, \mathbf{v} \rangle \mathbf{v}$,not $\mathbf{y}_p = \langle \mathbf{x}, \mathbf{y} \rangle \mathbf{v}$.

p 174, Ex 4.26: Change "Let $Y_1, Y_2, ..., Y_n$ be" to "Let $X_1, X_2, ..., X_n$ be."

p 177, Ex 4.48: Change "in Exercise 4.46" to "in Exercise 4.45."

p 177, Ex 4.49: Replace the values of σ_{23} and σ_{32} with 1 to avoid the indefiniteness. Then, the matrix $\mathbf{\Sigma}$ should read

$$\mathbf{\Sigma} = \begin{bmatrix} 3 & -1 & 0 \\ -1 & 2 & 1 \\ 0 & 1 & 4 \end{bmatrix}.$$

p 177, Ex 4.50: The question should read "Using $\mathbf{\Sigma}$ given in Ex 4.49, find the covariance of ....."

p 184, Eq (5.17): The displayed equation should read

$$f_{\mathbf{Y}}(\mathbf{y}) = \prod_{i=1}^{n} \left\{ \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2\sigma^2} \left(y_i - \beta_0 - \sum_{j=1}^{m} x_{ij}\beta_j \right)^2 \right] \right\}.$$

Omit the summation inside the exp term.

p 185, Eq (5.27): In the first line, change "$\left\langle \mathbf{X}\boldsymbol{\beta}, \mathbf{X}\hat{\boldsymbol{\beta}} \right\rangle -$" to "$\langle \mathbf{X}\boldsymbol{\beta}, \mathbf{X}\boldsymbol{\beta} \rangle -$." The hat is removed.

p 206, 12–: Change "Equation (5.109)" to "Equation (5.20)."

p 208, 6–: Change "$Var\left(\hat{\beta}_i\right) =^2 \sigma^2\delta_i$" to "$Var\left(\hat{\beta}_i\right) = \sigma^2\delta_i$."

p 209, Theorem 5.5 (iv): Change "$\left[\mathbf{C}(\mathbf{X}^T\mathbf{X})^{-1}\mathbf{C}\right]^{-1}$" to "$\left[\mathbf{C}(\mathbf{X}^T\mathbf{X})^{-1}\mathbf{C}^T\right]^{-1}$" in the numerator Eq. (5.123).

p 212, 1-2: Remove two lines from the top, the item (v) and Eq (5.139). These are repeated twice since it is given in the page before this.

p 213, 12–: The line should read "In addition, we ... that $Cov\left(\hat{\beta}_0, \hat{\beta}_1\right) = -\sigma^2 \sum_{i=1}^{n} x_i/nS_{xx} = -\sigma^2\overline{x}/S_{xx}$ which...." The term σ^2 are missing in two places. In fact, this is agreeable with Eq. (3.68) on page 70 in Chapter 3 as mentioned.

p 216, Table 5.7: For the quantity s^2, it should read $T_i = \frac{\hat{\beta}_i - \beta_i}{s/\sqrt{\delta_i}}$. The table is only correct under the presumption that $\beta_i = 0$.

p 220, Eq (5.188): Change "$\left(\mathbf{I}_n - \dfrac{\mathbf{E}}{n}\right)$" to "$\left(\mathbf{I}_n - \dfrac{\mathbf{E}}{n}\right)\mathbf{X}$."

p 243, Ex 5.3: Change "$\mathbf{B} = (\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}$" to "$\mathbf{B} = (\mathbf{X}^T\mathbf{X})^{-1}\mathbf{X}^T$."

p 250, Eq (6.1): Change "$\mathbf{H}\hat{\mathbf{y}}$" to "$\mathbf{H}\mathbf{y}$." Remove the hat.

p 268, Eq (6.46): Change "$\hat{y}_{(-1)}$" to "$\hat{y}_{(-i)}$." The subscript is changed from 1 to i.

p 268, Eq (6.48): The displayed equation, $SSE_{(-i)}$ should be

$$SSE_{(-i)} = \sum_{j=1}^{n} \hat{\varepsilon}_j^2 - \frac{\hat{\varepsilon}_i^2}{1 - h_{ii}}.$$

That is, the denominator of the second term on the right hand side of the equation should be changed from "h_{ii}" to "$1 - h_{ii}$."

p 269, Eq (6.54): Change "$\hat{\boldsymbol{\beta}}_i$" to "$\hat{\boldsymbol{\beta}}$." Remove the subscript i.

p 269, Eq (6.57): The displayed expansion should read

$$\sum_{j=1}^{n} \hat{\varepsilon}_j^2 + \frac{2\hat{\varepsilon}_i}{1 - h_{ii}} \sum_{j=1}^{n} h_{ij}\hat{\varepsilon}_j + \frac{\hat{\varepsilon}_i^2}{(1 - h_{ii})^2} \sum_{j=1}^{n} h_{ij}^2 - \frac{\hat{\varepsilon}_i^2}{(1 - h_{ii})^2}.$$

The last term $-\hat{\varepsilon}_i^2/(1 - h_{ii})^2$ is missing.

p 271, 2–: The line should read "Using $\hat{\boldsymbol{\beta}} - \hat{\boldsymbol{\beta}}_{(-i)} = (\mathbf{X}^T\mathbf{X})^{-1}\mathbf{x}_i^T\hat{\varepsilon}_i/(1 - h_{ii})$ as ..." Please also refer Eq (6.52).

p 272, Eq (6.69): The denominator on the right hand side of this displayed equation should read

$$DFBETAS_{j,i} = \cdots = \frac{r_{ji}}{\sqrt{\mathbf{r}_j^T\mathbf{r}_j}} \frac{\hat{t}_i}{\sqrt{1 - h_{ii}}}.$$

The term $(1 - h_{ii})$ in the denominator should be inside of the square root.

p 272, 4–: The line should read "popular choice of $\mathbf{M}$ is $(\mathbf{X}^T\mathbf{X})$ and ..." That is, remove the inverse.

p 273, 2: In the first line of Eq. (6.72), on the right hand side inner product should be

$$\left\langle (\mathbf{X}^T\mathbf{X})^{-1} \frac{\mathbf{x}_i^T\hat{\varepsilon}_i}{1 - h_{ii}}, (\mathbf{X}^T\mathbf{X}) \frac{(\mathbf{X}^T\mathbf{X})^{-1}}{1 - h_{ii}} \mathbf{x}_i^T\hat{\varepsilon}_i \right\rangle.$$

The inverse is missing in the first term $(\mathbf{X}^T\mathbf{X})$.

p 276, 6–: Change "in [?]" to "in [115]." The reference number is missing.

p 290, Eq (6.122): The second line should read

$$= \left[\left(\sqrt{\mathbf{W}}\mathbf{X}\right)^T \sqrt{\mathbf{W}}\mathbf{X} \right]^{-1} \left(\sqrt{\mathbf{W}}\mathbf{X}\right)^T \sqrt{\mathbf{W}}\mathbf{y}.$$

p 304, 1: Below Fig 6.23, change "the Cochran-Orcutt" to "the Cochrane-Orcutt." Cochrane's name is misspelled.

p 306, Eq (6.188): The last expression should be

$$= (\mathbf{X}^T\mathbf{W}^{-1}\mathbf{X})^{-1}\mathbf{X}^T\mathbf{W}^{-1}\mathbf{y}.$$

That is, in the parentheses $\mathbf{W}$ is changed to $\mathbf{W}^{-1}$.

p 309, Ex. 6.3: Change "which minimizeS" to "which minimizes." It has to be the lower-case.

p 424, Reference [56]: Change "*Ammerican*" to "*American.*" It is misspelled.

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