Data Analysis Exercises for Chapter 9: *Applied Regression Analysis, Generalized Linear Models, and Related Methods, Second Edition* (Sage, 2007)

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Exercise D9.1 Using a calculator or a computer program that conveniently performs matrix computations, and working with regression that you performed in Exercise D5.5:[1]

(a) Compute the least-squares regression coefficients, $\mathbf{b} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{y}$.

(b) Verify that the least-squares slope coefficients $\mathbf{b}_1 = [B_1, B_2, \ldots, B_k]'$ can be computed as $\mathbf{b}_1 = (\mathbf{X}^{*\prime}\mathbf{X}^*)^{-1}\mathbf{X}^{*\prime}\mathbf{y}^*$ where $\mathbf{X}^*$ and $\mathbf{y}^*$ contain mean deviations for the X's and Y, respectively.

Exercise D9.2 Using a calculator or a computer program that performs matrix computations, and working with the Canadian occupational prestige data (continuing Exercise D9.1):

(a) Calculate the estimated error variance, $S_E^2 = \mathbf{e}'\mathbf{e}/(n-k-1)$ (where $\mathbf{e} = \mathbf{y} - \mathbf{X}\mathbf{b}$), and the estimated covariance matrix of the coefficients, $\widehat{V}(\mathbf{b}) = S_E^2(\mathbf{X}'\mathbf{X})^{-1}$.

(b) Verify that the estimated covariance matrix for the slope coefficients $\mathbf{b}_1 = [B_1, B_2, \ldots, B_k]'$ in this regression can be calculated as $\widehat{V}(\mathbf{b}_1) = S_E^2(\mathbf{X}^{*\prime}\mathbf{X}^*)^{-1}$, where $\mathbf{X}^*$ is the mean-deviation matrix for the X's.

[1] Many computer programs (for example, APL, Gauss, Lisp-Stat, Mathematica, R, S-PLUS, SAS/IML, and Stata) include convenient facilities for matrix calculations.