Multiple Regression Formulas:

$$b = (X'X)^{-1} X' Y \qquad \hat{Y} = X b = H Y$$

$$H = X(X'X)^{-1} X' \qquad e = Y - \hat{Y} = Y - X b = (I - H) Y$$

$$MSR = \frac{SSR}{p-1} , \qquad MSE = \frac{SSE}{n-p} \qquad (\text{where } p = k+1)$$

$$F^* = \frac{MSR}{MSE} , \qquad R^2 = \frac{SSR}{SSTO} = 1 - \frac{SSE}{SSTO}$$

$$R_a^2 = 1 - \frac{SSE/(n-p)}{SSTO/(n-1)}$$

For a constant matrix A, $\quad E(A Y) = A E(Y)$

$$\text{var}(A Y) = A \, \text{var}(Y) \, A'$$

CI for β_j:

$$b_j \pm t_{(1-\alpha/2, \, n-p)} \sqrt{MSE \, c_{jj}}$$

t-test for
$H_0: \beta_j = 0$

$$t^* = \frac{b_j}{\sqrt{MSE \, c_{jj}}} , \quad \text{where } c_{jj} = j\text{-th diagonal element of } (X'X)^{-1}$$

CI for $E(Y_h)$ at a set of X-values X_h:

$$\hat{Y}_h \pm t_{(1-\alpha/2; \, n-p)} \sqrt{MSE \, X_h' (X'X)^{-1} X_h}$$

PI for $Y_{h(new)}$ at X_h:

$$\hat{Y}_h \pm t_{(1-\alpha/2; \, n-p)} \sqrt{MSE \left[1 + X_h' (X'X)^{-1} X_h \right]}$$

"Extra SS" F-test:

$$F^* = \frac{[SSE(reduced) - SSE(full)]/(\#\ parameters\ in\ test)}{MSE(full)}$$

$$VIF = \frac{1}{1-R_j^2} \qquad AIC = n\ ln(SSE_p) - n\ ln(n) + 2p$$

$$BIC = n\ ln(SSE_p) - n\ ln(n) + [ln(n)]p$$

$$C_p = \frac{SSE_p}{MSE_{full}} - n + 2p$$

$$MSPR = \frac{\sum_{i=1}^{n^*}(Y_i - \hat{Y}_i)^2}{n^*} \quad , \qquad PRESS = \sum_{i=1}^{n}(Y_i - \hat{Y}_{i(i)})^2$$

Outliers + Influential Cases:

$$r_i = \frac{e_i}{\sqrt{MSE(1-h_{ii})}} \quad , \qquad t_i = \frac{e_i}{\sqrt{MSE_{(i)}(1-h_{ii})}}$$

Rules of Thumb:

$$h_{ii} > \frac{2p}{n} \quad , \quad |DFFITS_i| > 2\sqrt{\frac{p}{n}} \quad , \quad Cook's\ D_i > F_{(.5,\ p,\ n-p)}$$

$$DFFITS_i = \frac{\hat{Y}_i - \hat{Y}_{i(i)}}{\sqrt{MSE_{(i)}h_{ii}}} \quad , \quad Cook's\ D_i = \frac{\sum_{j=1}^{n}(\hat{Y}_j - \hat{Y}_{j(i)})^2}{p\ MSE}$$