Equations for OLS slope and intercept estimators (one independent variable)

$$\hat{B}_0 = \overline{Y} - \hat{B}_1 \overline{X} \qquad \hat{B}_1 = \frac{\sum (Y_i - \overline{Y})(X_i - \overline{X})}{\sum (X_i - \overline{X})^2} = \frac{n\sum Y_i X_i - \sum Y_i \sum X_i}{n\sum X_i^2 - \left(\sum X_i\right)^2} = \frac{\sum x_i y_i}{\sum x_i^2} = \sum c_i Y_i$$

where $$c_i = \frac{x_i - \overline{x}}{\sum (x_i - \overline{x})^2}$$

Equations for OLS slope and intercept estimators (two independent variables)

$$\hat{B}_1 = \frac{\left(\sum y_i x_{1i}\right)\left(\sum x_{2i}^2\right) - \left(\sum y_i x_{2i}\right)\left(\sum x_{1i} x_{2i}\right)}{\left(\sum x_{1i}^2\right)\left(\sum x_{2i}^2\right) - \left(\sum x_{1i} x_{2i}\right)^2}$$

$$\hat{B}_0 = \overline{Y} - \hat{B}_1 \overline{X}_1 - \hat{B}_2 \overline{X}_2$$

$$\hat{B}_2 = \frac{\left(\sum y_i x_{2i}\right)\left(\sum x_{1i}^2\right) - \left(\sum y_i x_{1i}\right)\left(\sum x_{1i} x_{2i}\right)}{\left(\sum x_{1i}^2\right)\left(\sum x_{2i}^2\right) - \left(\sum x_{1i} x_{2i}\right)^2}$$

Standard Error of the slope coefficients (one independent variable)

$$SE(\hat{B}_0) = \sqrt{\frac{\hat{\sigma}^2 \sum X_i^2}{n\sum x_i^2}} \qquad SE(\hat{B}_1) = \sqrt{\frac{\hat{\sigma}^2}{\sum x_i^2}}$$

Standard Error of the slope coefficients (two independent variables)

$$SE(\hat{B}_1) = \sqrt{\frac{\hat{\sigma}^2}{\left(1 - r_{1,2}^2\right)\sum x_{1i}^2}} \qquad SE(\hat{B}_2) = \sqrt{\frac{\hat{\sigma}^2}{\left(1 - r_{1,2}^2\right)\sum x_{2i}^2}}$$

Residual Equations

$$\sum (Y_i - \overline{Y})^2 = \sum \left(\hat{Y}_i - \overline{Y}\right)^2 + \sum e_i^2 \qquad R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS} = 1 - \frac{\sum e_i^2}{\sum (Y_i - \overline{Y})^2}$$

$$\hat{\sigma}^2 = \frac{\sum e_i^2}{n - K - 1} \qquad e_i = Y_i - \hat{B}_0 - \hat{B}_1 X_i \qquad \hat{\sigma}_f^2 = \hat{\sigma}^2 \left[1 + \frac{1}{n} + \frac{(X_f - \overline{X})^2}{\sum (X_i - \overline{X})^2}\right]$$

$$\text{Durbin Watson} = \frac{\sum (e_t - e_{t-1})^2}{\sum e_t^2}$$

Hypothesis Testing

$$t_k = \frac{\hat{B}_k - B_{H_0}}{se(\hat{B}_k)} \qquad F = \frac{(RSS_M - RSS)/M}{RSS/(n - K - 1)}$$