# Equations – Formulas

**Chapter 2:**

$$b_2 = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sum(x_i - \bar{x})^2}$$

$$b_1 = \bar{y} - b_2\bar{x}$$

$$Var(b_1) = \sigma^2 \left[\frac{\sum x_i^2}{N\sum(x_i - \bar{x})^2}\right]$$

$$Var(b_2) = \frac{\sigma^2}{\sum(x_i - \bar{x})^2}$$

$$Cov(b_1, b_2) = \sigma^2 \left[\frac{-\bar{x}}{\sum(x_i - \bar{x})^2}\right]$$

$$\hat{\sigma}^2 = \frac{\sum \widehat{e_i}^2}{N - 2}$$

**Chapter 4:**

$$\hat{y}_0 = b_1 + b_2x_0$$

$$Var(f) = \sigma^2 \left[1 + \frac{1}{N} + \frac{(x_0 - \bar{x})^2}{\sum(x_i - \bar{x})^2}\right] = \sigma^2 + \sigma^2\frac{1}{N} + (x_0 - \bar{x})^2 Var(b_2), f = y_0 - \hat{y}_0$$

$$R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}$$

$$SST = \sum(y_i - \bar{y})^2$$

$$SSR = \sum(\hat{y}_i - \bar{y})^2$$

$$SSE = \sum \widehat{e_i}^2$$

Natural predictor: $\hat{y}_n = exp\left(\widehat{lny}\right)$

Corrected predictor: $\hat{y}_c = exp\left(\widehat{lny}\right)exp(\hat{\sigma}^2/2)$

**Chapter 5:**

$$\hat{\sigma}^2 = \frac{\sum \widehat{e_i}^2}{N - K}$$

**Chapter 6:**

General formula for the F-statistic: $F = \frac{(SSE_R - SSE_U)/J}{SSE_U/(N-K)}$

The F-statistic testing for the joint statistical significance of a model: $F = \frac{(SST - SSE)/(K-1)}{SSE/(N-K)}$

$$\overline{R^2} = 1 - \frac{SSE/(N-K)}{SST/(N-1)}$$

$$AIC = ln\left(\frac{SSE}{N}\right) + \frac{2K}{N}$$

$$SC = ln\left(\frac{SSE}{N}\right) + \frac{Kln(N)}{N}$$

**Chapter 9:**

$$r_k = \frac{\sum_{t=k+1}^{T}(y_t - \bar{y})(y_{t-k} - \bar{y})}{\sum_{t=1}^{T}(y_t - \bar{y})^2}$$

AR(1) model $e_t = \rho e_{t-1} + v_t, -1 < \rho < 1: E(e_t) = 0, Var(e_t) = \frac{\sigma_v^2}{1-\rho^2}, Cov(e_t, e_{t-k}) = \frac{\rho^k \sigma_v^2}{1-\rho^2}$, $Corr(e_t, e_{t-k}) = \rho^k$