

Political Science 328

Regression by Hand Formulas

Sample Mean: $\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$ (S&W 2.43 using X)

Sample Standard Deviation: $s_X = sd(X) = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2}$ (from S&W 3.7)

Correlation Coefficient : $r = \frac{s_{XY}}{s_X s_Y} = \frac{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\frac{1}{n-1} \sum_{i=1}^n (Y_i - \bar{Y})^2}}$

$= \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}}$ (S&W 3.25)

Estimated Slope: $b_1 = \frac{s_{XY}}{s_X^2} = \frac{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^n (X_i - \bar{X})^2}$ (S&W 4.7)

Estimated Intercept: $b_0 = \bar{Y} - b_1 \bar{X}$ (S&W 4.8)

Predicted Value: $\hat{Y}_i = b_0 + b_1 X_i$ (S&W 4.9)

Residual: $\hat{u}_i = Y_i - \hat{Y}_i$ (S&W 4.10)

$R^2 = \frac{ESS}{TSS} = 1 - \frac{SSR}{TSS} = 1 - \frac{\sum_{i=1}^n \hat{u}_i^2}{\sum_{i=1}^n (Y_i - \bar{Y})^2}$ (S&W 4.15, 4.17, 4.18)

$SER = s_{\hat{u}} = \sqrt{\frac{SSR}{n-2}} = \sqrt{\frac{\sum_{i=1}^n \hat{u}_i^2}{n-2}}$ (from S&W 4.19)