POLS 503: Advanced Quantitative Political Methodology: The Notes

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Chapter 1

Introduction

hello, world!

Chapter 2

Linear Regression

2.1 Matrix Representation

The linear regression function can be written as a scalar function for each observation, $i = 1, \ldots, N$,

$$\begin{aligned} y_i &= \beta_0 + \beta_1 x_{1,i} + \beta_2 x_{2,i} + \cdots + \beta_{K,i} + \varepsilon_i \\ &= \beta_0 + \sum_{k=1}^{K} \beta_k x_{k,i} + \varepsilon_i \\ &= \sum_{k=0}^{K} \beta_k x_{k,i} + \varepsilon_i \end{aligned}$$

where $x_{0,i} = 1$ for all $i \in 1 : N$.

The linear regression can be more compactly written in matrix form,

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix} = \begin{bmatrix} 1 & x_{1,1} & x_{2,1} & \cdots & x_{K,1} \\ 1 & x_{1,2} & x_{2,2} & \cdots & x_{K,2} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_{1,N} & x_{2,n} & \cdots & x_{K,N} \end{bmatrix} \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \\ \vdots \\ \beta_K \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_N \end{bmatrix}$$

$$\underbrace{\boldsymbol{y}}_{N \times 1} = \underbrace{\boldsymbol{X}}_{N \times K} \underbrace{\boldsymbol{\beta}}_{K \times 1} + \underbrace{\boldsymbol{\varepsilon}}_{N \times 1}$$

The matrix $\boldsymbol{X}$ is called the *design* matrix. Its rows are each observation in the data. Its columns are the intercept, a column vector of 1's, and the values of each predictor.

The mean of the disturbance vector is 0,

$$\mathrm{E}(\epsilon) = 0$$

2.2 Estimating OLS

The OLS estimator finds estimates of a paramters