

Linear Model : basics

functional form:

$$y_i = \beta_0 + \sum_{j=1}^p \beta_j x_{ij} + \varepsilon_i \quad \text{with}$$

$$\varepsilon_i \stackrel{\text{iid}}{\sim} N(0, \sigma^2), \quad i=1, \dots, n$$

matrix representation:

$$\underline{y} = \underline{X} \underline{\beta} + \underline{\varepsilon} \quad \text{with} \quad \underline{\varepsilon} \stackrel{\text{iid}}{\sim} N(0, \sigma^2 \underline{I}_n)$$

estimation of $\underline{\beta}$ typically done via Ordinary Least Squares (OLS) by

$$\hat{\underline{\beta}} = (\underline{X}^T \underline{X})^{-1} \underline{X}^T \underline{y}$$

sampling distribution of the OLS estimator:

$$\hat{\underline{\beta}} \sim N(\underline{\beta}, \sigma^2 (\underline{X}^T \underline{X})^{-1})$$