Properties of Model in Matrix-vector notation

- expected value of y:

$$E(y_1) = b_0 + b_1 x_{11} + b_2 x_{12}$$

$$E(y_2) = b_0 + b_1 x_{21} + b_2 x_{22}$$

$$\vdots$$

- Define

$$E[y] = \begin{bmatrix} E(y_1) \\ E(y_2) \\ \vdots \\ E(y_N) \end{bmatrix} = \begin{bmatrix} b_0 + b_1 x_{11} + b_2 x_{12} \\ b_0 + b_1 x_{21} + b_2 x_{22} \\ \vdots \\ b_0 + b_1 x_{N1} + b_2 x_{N2} \end{bmatrix} = \begin{bmatrix} x_{10} & x_{11} & x_{12} \\ x_{20} & x_{21} & x_{22} \\ x_{N0} & x_{N1} & x_{N2} \end{bmatrix} \begin{bmatrix} b_0 \\ b_1 \\ b_2 \end{bmatrix}$$

$$= X \cdot b$$

- Verify:

$$E[y] = E[Xb + e] = E[Xb] + \underbrace{E[e]}_{=0} = E[Xb] + 0$$

$$= E[Xb] = Xb$$

- Error Terms: $E[e] = 0$; expected value

$$\mathrm{var}(e) = E[e - \underbrace{E(e)}_{0}][e - \underbrace{E(e)}_{=0}]^T = E[ee^T] = \sigma^2 I_N$$

Identity matrix with dimension $N \times N$