Matrix-Vector Notation for Linear Regression

- All x-variable are put into Matrix X:

$$\underline{X} = \begin{bmatrix} x_{10} & x_{11} & x_{12} \\ x_{20} & x_{21} & x_{22} \\ \vdots & \vdots & \vdots \\ x_{N0} & x_{N1} & x_{N2} \end{bmatrix} \quad N=10$$

column of all "1" — BC — HEI

$x_{10} = x_{20} = \ldots = x_{N0} = 1$

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}, \quad e = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_N \end{bmatrix}, \quad b = \begin{bmatrix} b_0 \\ b_1 \\ b_2 \end{bmatrix} \begin{array}{l} \rightarrow \text{intercept} \\ \rightarrow \text{slope for BC} \\ \rightarrow \text{slope for HEI} \end{array}$$

respance vector

BTW ———

- Regression Model: $\underline{y = X \cdot b + e}$ → the same for any number N and any number k of x-variables.

$$\begin{bmatrix} y_1 \\ \vdots \end{bmatrix} = \begin{bmatrix} x_0 & x_{11} & x_{12} \\ \vdots & \vdots & \vdots \end{bmatrix} \cdot \begin{bmatrix} b_0 \\ b_1 \\ b_2 \end{bmatrix} + \begin{bmatrix} e_1 \\ \vdots \end{bmatrix}$$

$$y_1 = x_{10} \cdot b_0 + x_{11} \cdot b_1 + x_{12} \cdot b_2 + e_1$$