How estimate $\underline{b}$:

- Elements in vector $\underline{b}$ are unknown
  $\Rightarrow$ estimate from data using Least Squares

$$L = \underline{e}^T\underline{e} = \begin{bmatrix} e_1 & e_2 & e_3 \cdots e_N \end{bmatrix} \cdot \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_N \end{bmatrix} = e_1^2 + e_2^2 + \cdots + e_N^2$$

$$L = \sum_{i=1}^{N} e_i^2 = e_1^2 + e_2^2 + \cdots + e_N^2$$

$$L = \underline{e}^T\underline{e} = (\underline{y} - X\underline{b})^T \cdot (\underline{y} - X\underline{b})$$

$$= (\underline{y}^T - (X\underline{b})^T) \cdot (\underline{y} - X\underline{b})$$

$$= (\underline{y}^T - \underline{b}^T X^T) \cdot (\underline{y} - X\underline{b})$$

$$\underline{y}^T\underline{y} - \underline{y}^T X\underline{b} - \underline{b}^T X^T \underline{y} + \underline{b}^T X^T X\underline{b}$$

$$(\underline{b}^T X^T \underline{y})^T = \underline{y}^T X\underline{b}$$

$$= \underline{y}^T\underline{y} - 2\underline{y}^T X\underline{b} + \underline{b}^T X^T X\underline{b}$$

Least Squares: Find vector $\underline{b}$ such that