Transposing a matrix

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \rightarrow A^T = ?$$

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \end{bmatrix} \rightarrow A^T = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & \vdots \\ a_{31} & \end{bmatrix}$$

$$b = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_p \end{bmatrix}_{p \times 1} \cdot \quad c = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_p \end{bmatrix}_{p \times 1}$$

Vector x vector multiplication

$$\cancel{b_{p\times 1} \cdot c_{p \times 1}}$$

$$b^T = \begin{bmatrix} b_1 & b_2 & \dots & b_p \end{bmatrix}_{1 \times p} \cdot \quad c = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_p \end{bmatrix}_{p \times 1}$$

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t X %~~*~~% X

$$X_{2\times 3} \ \%*\% \ tX_{3 \times 2} \rightarrow W_{2 \times 2} \neq Z = tX \ \%*\% X$$

Order matters when multiplying matrices!

Converting vectors to column matrices, and multiplying

$$b = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}, \quad c = \begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix}$$

$$b \cdot c^T \rightarrow \underset{3\times 1}{\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}} \cdot \underset{1\times 3}{\begin{bmatrix} 4 & 5 & 6 \end{bmatrix}}$$

$$= \underset{3\times 3}{\begin{bmatrix} 4 & 5 & 6 \\ 8 & 10 & 12 \\ \cdot & \cdot\ \cdot & \cdot\ \cdot \end{bmatrix}} \checkmark$$

Vector/matrix representation Of regression equation

$$\beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \end{bmatrix} \qquad X = \begin{bmatrix} 1 & X_{11} & X_{12} \\ 1 & X_{21} & X_{22} \\ \vdots & \vdots & \\ 1 & X_{n1} & X_{n2} \end{bmatrix}$$

$$X_i = \begin{bmatrix} 1 \\ X_{21} \\ X_{22} \end{bmatrix}$$

$$y_i = \underbrace{\begin{bmatrix} \beta_0 & \beta_1 & \beta_2 \end{bmatrix}} \cdot \underbrace{\begin{bmatrix} 1 \\ X_{21} \\ X_{22} \end{bmatrix}} + \varepsilon_i$$

$$y_i = \beta^T \cdot X_i + \varepsilon_i$$

The mechanics of the exponentiation function

$$e \approx 2.71$$

$$\exp(x) = 2.71^x$$

if $x = 3$

$$\hookrightarrow \exp(3) = 2.71 \cdot 2.71 \cdot 2.71$$

$$\exp(a+b) = \exp(a) \cdot \exp(b)$$

$$\exp(3) = \exp(2+1) = \underbrace{2.71 \cdot 2.71}\cdot\underbrace{2.71} =$$

$$= \exp(2) \cdot \exp(1)$$

Demonstrating the reciprocal nature of logit and expit functions

$$\text{logit}(p) = \log\left(\frac{p}{1-p}\right) = y$$

$$\text{expit}(y) = \frac{\exp(y)}{1+\exp(y)} = p$$

$$= \frac{\cancel{\exp}\left(\cancel{\log}\left(\frac{p}{1-p}\right)\right)}{1+\cancel{\exp}\left(\cancel{\log}\left(\frac{p}{1-p}\right)\right)} = \frac{\frac{p}{1-p}}{1+\frac{p}{1-p}} =$$

$$= \frac{p}{(1-\cancel{p})+\cancel{p}} = p$$