Day 2 Worksheet: Linear Algebra

SOC Methods Camp

September 4th, 2019

Dot product

$$\begin{aligned} &= [Mary\,L. \quad Tim\,J. \quad Jon\,C.] \\ Paul\,Wellstone = \mathbf{u} &= \begin{bmatrix} 0 & 8 & 2 \end{bmatrix} \\ Joe\,Lieberman = \mathbf{v} &= \begin{bmatrix} 4 & 2 & 6 \end{bmatrix} \\ Dianne\,Feinstein = \mathbf{z} &= \begin{bmatrix} 3 & 1 & 1 \end{bmatrix} \end{aligned}$$

Cross product

$$\mathbf{A} = \begin{bmatrix} \mathbf{u} \\ \mathbf{v} \end{bmatrix} = \begin{bmatrix} Sen1 \\ Sen2 \end{bmatrix} = \begin{bmatrix} Mary\,L. & Tim\,J. & Jon\,C. \end{bmatrix} \begin{bmatrix} 2 & 4 & 1 \\ 6 & 12 & 3 \end{bmatrix}$$

Practice with matrix multiplication

Practice with conformability and multiplication

$$\mathbf{Y} = \begin{bmatrix} 3 & 1 & -2 \\ 6 & 3 & 4 \end{bmatrix}, \ \mathbf{X} = \begin{bmatrix} 4 & 2 \\ 3 & 0 \\ 1 & 2 \end{bmatrix}$$

1. Write out dimensions of each
2. Arrange multiplication in a way that makes matrices conformable to multiply
3. Multiply by hand

Practice with transpose

1. The dimensions of the $Y - X\beta$. Hint: what are the dimensions of $X\beta$ and then what are the dimensions of Y minus that result?
2. Given those dimensions, how would you would use transpose to make the following multiplication 1) conformable, 2) produce a 1×1 result?: $(Y - X\beta)(Y - X\beta)$
3. After step two, if it involves transposing one or both of the $Y - X\beta$, how would those transposes be distributed using the properties on the previous slide (we can flip back),

Matrices:

$$\underset{5\times3}{\mathbf{X}} = \begin{bmatrix} x_{11} & \dots & x_{31} \\ \vdots & & \vdots \\ x_{51} & \dots & x_{53} \end{bmatrix}, \quad \underset{5\times1}{\mathbf{Y}} = \begin{bmatrix} y_{11} \\ \vdots \\ y_{51} \end{bmatrix}, \quad \underset{3\times1}{\beta} = \begin{bmatrix} \beta_{11} \\ \beta_{21} \\ \beta_{31} \end{bmatrix}$$

Practice matrix Inversion

Find A^{-1}:

$$A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$$