HDDA Tutorial: MatrixBasics

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Tutorial 7

Vectors

Consider the vectors

$$\mathbf{a} = \begin{pmatrix} 2 \\ 4 \end{pmatrix} \quad \mathbf{b} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad \mathbf{c} = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$$

Work out the following (without using R). All multiplication is matrix multiplication.

1. $\mathbf{a} + \mathbf{b}$
2. $\mathbf{a}'\mathbf{a}$
3. $\mathbf{a}'\mathbf{b}$
4. $\mathbf{a}'\mathbf{c}$
5. $\mathbf{a}\mathbf{b}'$

Matrices

Consider the matrices

Work out the following (without using R). All multiplication is matrix multiplication.

$$\mathbf{X} = \begin{pmatrix} 1 & 2 \\ 1 & 4 \\ 0 & -1 \end{pmatrix} \quad \mathbf{Y} = \begin{pmatrix} 2 & -1 \\ 3 & 0 \\ 3 & -1 \end{pmatrix}$$

1. $\mathbf{X} + \mathbf{Y}$
2. $\mathbf{X}\mathbf{Y}$
3. $\mathbf{X}'\mathbf{Y}$

Vectors and Matrices in R

Repeat all above questions using R. Useful functions are `c` for setting a vector, `matrix` for setting a matrix and `t` for the transpose. Also note that `*` does NOT do matrix multiplication. Instead use `%*%`.

Data matrix

Consider the data matrix $\mathbf{Y}$

$$\mathbf{Y} = \begin{pmatrix} y_{11} & y_{12} & \cdots & y_{1p} \\ y_{21} & y_{22} & \cdots & y_{2p} \\ \vdots & \vdots & \cdots & \vdots \\ y_{n1} & y_{n2} & \cdots & y_{np} \end{pmatrix}$$

where y_{ij} is the value of variable j for observation i

1. How many rows are there in $\mathbf{Y}$?
2. How many columns are there in $\mathbf{Y}$?
3. What are the dimensions of $\mathbf{Y}$?
4. Find an expression for the first row and first column of $\mathbf{S} = \frac{1}{n-1}\mathbf{Y}'\mathbf{Y}$