

# ACS234

# Maths and Data Modelling

**Tutorial 3**  
**Wednesday 1pm LT04**

<https://github.com/ineskris/ACS234/tree/master/Tutorial3>

## Done in Lecture (week 5)

- Multiple Linear Regression

# Matrix - Basics

Matrix 2 x 2

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

Transpose

$$A^T = A' = \begin{pmatrix} a & c \\ b & d \end{pmatrix}$$

Inverse

$$A^{-1} = \frac{1}{ad - bc} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$$

Multiplication Matrix 2 x 2

$$\begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \times \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix} = \begin{pmatrix} a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} \\ a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22} \end{pmatrix}$$

**Exercise 1** - Let A, B, D be the matrices below.

$$A = \begin{pmatrix} 1 & -2 \\ 3 & 0 \end{pmatrix} \quad B = \begin{pmatrix} 4 & 4 \\ -1 & 1 \end{pmatrix} \quad C = \begin{pmatrix} 7 \\ 0 \end{pmatrix} \quad D = (-3 \quad 1)$$

Compute AB, BA, BB', B'B, AC, BD' and  $A^{-1}$

# Multiple Linear Regression

Multiple regression is like linear regression, but with more than one independent value, meaning that we try to predict a value based on **two or more** variables.

$$y = a_0 + a_1x_1 + a_2x_2 + \dots + a_mx_m + e$$

Response                      Coefficients                      Variables

**Prediction**

$$Y = \hat{a}X + e \qquad \hat{a} = (X'X)^{-1}X'Y$$

<b>Coefficient of determination</b>	$R^2 = 1 - \frac{S_r}{S_t}$	<b>Sum of squared deviations</b>	$S_t = \sum_{i=1}^n (y_i - \bar{y})^2$
<b>Standard Error of Estimate</b>	$S_{y/x} = \sqrt{\frac{S_r}{n - (m + 1)}}$	<b>Sum of squares of the errors</b>	$S_r = \sum_{i=1}^n (y_i - \hat{y}_i)^2$

# Case Study

Can you use a multiple regression model to predict the housing price in Boston ?

**<https://github.com/ineskris/ACS234/blob/master/Tutorial3/Tutorial3.ipynb>**

**Exercise 2** - Find the coefficients of the model  $a_1$  and  $a_2$  as well as  $R^2$  using only the data in the red box.

Wgt	Gest	Smoke
2940	38	yes
3130	38	no
2420	36	yes
2450	34	no
2760	39	yes
2440	35	yes
3226	40	no
3301	42	yes
2729	37	no
3410	40	no
2715	36	yes
3095	39	no
3130	39	yes
3244	39	no
2520	35	no
2928	39	yes
3523	41	no
3446	42	yes
2920	38	no
2957	39	yes
3530	42	no
2580	38	yes
3040	37	no
3500	42	yes
3200	41	yes
3322	39	no
3459	40	no
3346	42	yes
2619	35	no
3175	41	yes
2740	38	yes
2841	36	no

$$\text{Weight} = a_1 \times \text{Gestation} + a_2 \times \text{Smoke}$$