MAS6012: Exercises 1

This set of exercises counts towards 10% of your total assessment on MAS6012. The deadline for submission is **Wednesday 27th Feb, noon**. Distance learners should email their work to me. Everyone else should hand in their work at the MAS6012 lecture on 27th Feb. Present your work in 'exam format': you must include all your working and present your solutions clearly, but otherwise, no marks will be awarded for presentation or commentary.

Your submitted solutions must be entirely your own work: do not work with anyone else on your exercises.

Your mark will be out of 100

1. A computer model is given by the function

$$Y = X_1^2 + 2X_2X_3.$$

The true values of the three inputs are uncertain, with $X_1 \sim N(6, 9)$, $X_2 \sim U[9, 14]$ and $X_3 \sim N(9, 1)$, with X_1, X_2, X_3 independent. The model user can choose to learn the true value of one of the inputs. The model user wishes to reduce the variance of the output Y as much as possible. Suggest which input the model user should choose to learn, justifying your reasoning.

2. A simple model (including R code implementation) of a cantilever beam is described on

http://www.sfu.ca/~ssurjano/canti.html.

For this question ignore the input variable R and the reponse $S(\mathbf{x})$.

Use the following input distributions for variables X, Y and E and values for L, w and t:

$$\begin{aligned} E &\sim N(1.9 \times 10^7, (1.7 \times 10^6)^2), \\ X &\sim N(500, 100^2), \\ Y &\sim N(1100, 100^2), \\ L &= 100, \\ w &= 4, \\ t &= 2. \end{aligned}$$

a) Modify the R code provided on the website to use only the three input variables X, Y and E and the single response variable $D(\mathbf{x})$. Include the R code in your solution.

b) Use a Monte Carlo approach to estimate the variance of the displacement, $Var(D(\mathbf{x}))$, where $\mathbf{x} = (E, X, Y)$. Include the R code in your solution.

c) Estimate the main effect indices of each of the three inputs E, X and Y using the GAM regression method. See Example 3.3.1 in the computer experiments notes and the corresponding R code on MOLE for help with implementing GAM regression. Include the R code in your solution.