# MAT013 Coursework

*Deadline: 8/5/2013 at 0900*

## Instructions

The outputs of this coursework will be:

* A written report describing your code (SAS and R) to be handed in to Joanna Emery.
* An appendix containing a commented version of your code (SAS and R) to be handed in to Joanna Emery.
* A file containing the required SAS code. Name this file SAS-lastname-STUDENTNUMBER (eg. Knight-123456) and email it to Joanna Emery with MAT013 as the subject. Note that all operations needed to complete the coursework should be included in the SAS code.
* A file containing the required R code. Name this file R-lastname-STUDENTNUMBER (eg. Knight-123456) and email it to Joanna Emery with MAT013 as the subject. Note that all operations needed to complete the coursework should be included in the R code.

## Coursework

1. Using both SAS and R (in other words attempt this question using SAS and then using R):

Write code (in SAS: a macro, in R: a function) that will reproduce a mathematical procedure covered in MAT001 or MAT002. Clearly document this procedure in your report.

[20]

1. Using SAS:

The data files [Greedy.csv](Data/Greedy.csv), [Random.csv](Data/Random.csv), [Longest.csv](Data/Longest.csv) and [Shortest.csv](Data/Shortest.csv) contain data relevant to the experimental play of 4 strategies for the game [Shut the Box](http://en.wikipedia.org/wiki/Shut_the_Box) (you do not necessarily need to know of this game to complete this coursework).

The four strategies will be referred to as:

* Greedy
* Random
* Longest
* Shortest

The data file contains two variables for each strategy: Score and Length. The aim of the game is to have the lowest score (a minimum of 0).

1. Obtain plots of the distribution of the Score variable for each strategy (represent these distributions on the same graph);
2. Obtain plots of the distribution of the Length variable for each strategy (represent these distributions on the same graph);
3. For each method are Score and Length related?
4. Do the strategies give different outcomes and if so which strategy seems to be the best?

[25]

1. Using R:

Write a function that will return the th [Fibonacci number](http://en.wikipedia.org/wiki/Fibonacci_number), .

Modify the function so that it returns the th number of the sequence defined by:

Where and are input parameters.

Adapt your function so that it will write all numbers of the form K(n) less than some number k to a csv file. The name of the csv file must not be an input parameter to the function but include the parameters and as well as the date on which the code was run. For example: general\_fib\_for-a=2-b=3-alpha=10-beta=-2\_1984-14-02.csv.

[25]

1. Using SAS or R.

The file [Solution\_Space\_Exploration.csv](Data/Solution_Space_Exploration.csv) contains experimental results pertaining to two approaches to solving an optimisation problem (aiming to minimize a cost function). These two approaches will be referred to as approach A and approach B. Approach B involves searching a space that contains the solution space that approach A searches. Thus approach B can at least match approach A.

Every row of the data file corresponds to a given instance of the optimisation problem and contains 6 variables which are (in order):

* A boolean variable indicating True if approach B finds a better solution than approach A: B\_optimal;
* The first dimension of the problem: m;
* The second dimension of the problem: n;
* A further problem parameter: tau;
* The optimal cost function obtained using method A: A\_Cost;
* The optimal cost function obtained using method B: B\_Cost;

1. Give summary statistics for all the variables. [5]
2. Obtain a 3 dimensional representation (eg surface or contour) showing the proportion of times that method B finds a better solution based on the dimensions of the problem. [5]
3. Obtain a distribution of the gains made by method B over method A. [10]
4. Explore and attempt to indicate parameters that influence the performance of either method (and when method B is better). [10]