Lab 1: Introductory Exercises in R and Calculus

After you learn the basics of R (see Introduction to R), answer the following 4 questions and submit your completed lab assignment at the beginning of your lab next week. You MUST provide the R code for all applicable questions. A correct answer without the code will not receive a full grade. This short assignment will be graded and will count toward your lab/assignment grade. Do not forget to provide your name and student number.

- **Question 1**
  1. Create a vector `x` containing the sequence $1, 4, 7, \ldots, 397, 400$
  2. Print the elements of `x` which are in an even position (the second component, the fourth etc).
  3. Determine how many entries from this vector are multiples of 7 and create a vector containing them.

- **Question 2**
  Download the data file `lab-1.csv` from the course web site to your working directory Z: (right click → Save Target As... → Save in Drive Z:). It include the height (meter) and weight (Kg) of a bunch of males and females.
  1. Give the average, the standard deviation and the extreme values of the variable height.
  2. Plot a histogram of weight.
  3. Using side-by-side boxplots compare the height of females and males.

- **Question 3**
  A "Taylor Series Expansion of the function f at c" is given by the formula
  $$f(x) = \sum_{i=0}^{\infty} \frac{f^{(i)}(c)}{i!}(x-c)^i$$
  The special case when $c = 0$ is called the "Maclaurin Series".
  1. Calculate the Maclaurin Series expansion of $f(x) = sin(x)$ for four terms. Generalize this result for an infinite number of terms, expressing your solution as a summation.

2. Plot (in R) the function $f(x) = sin(x)$, the four term Maclaurin Series expansion and the six term Maclaurin Series expansion as separate curves/functions for a range of values from -1 to 1.
3. Find the Maclaurin series for $f(x) = x^3 sin(x)$.

- **Question 4**

1. Find the derivative of $tan(\sqrt{x})$
2. Find the integral of $sin^2(x)$
3. Compute $\int_0^2 \sqrt{4 - x^2} dx$
4. What is the possible maximum area of a rectangle with a circumference of 10.