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*In these labs you should work through the problems on the sheet and type your answers into a Microsoft Word document. When you have completed the tasks, print the document and hand it in.*

*Your answers can benefit from having small sections of R output and graphs copied and pasted into your word document. It can be useful to limit the width of output produced by R so that it fits into your document. You can change the width of output produced by R with a command like: `options(width=50)`.*

*The labs will count for 1 mark in the current assignment. They will be graded on a 0-1 basis. Don't forget to put your name and student ID on the document.*

1. (a) Get logged into the computer and check that you are able to run the following applications:
  - (i) Internet Explorer
  - (ii) Microsoft Word
  - (iii) R

If you have problems, you may need to tweak your “AFS” setup. Double click on the little padlock icon at the bottom right of the screen. Check that the “p” drive has its check box on.

- (b) Use “Internet Explorer” to view the 120 class home page.

<http://www.stat.auckland.ac.nz/~ihaka/120>

Write a two sentence explanation of what it looks like.

2. When the mathematical prodigy Carl Friedrich Gauss was in school he often pestered his teacher after finishing his assigned work early. On one such occasion, his teacher told him to “go away and add up all the numbers from 1 to 100.” Gauss was back seconds later with the answer. He recognised that by adding the numbers from 1 to 100 pairwise to the same values in reverse order you could get the answer very quickly.
  - (a) Use R to verify Gauss’ insight. Use the sequence operator “:” to generate the sequences  $1, \dots, 100$  and  $100, \dots, 1$  and the addition operator “+” to add the sequences together. Use what you observe to get the desired sum. verify your answer by computing `sum(1:100)`.
  - (b) For the general problem of adding all the values from 1 to  $n$ , what is the answer?
  - (c) The R function “`cumsum`” computes cumulative sums (try it on the vectors `rep(1,10)` and `1:10` to see what it does). Verify your answer to part 2b by setting `n=1:100` and then computing `cumsum(n)` and applying your formula for part 2b to `n`.

3. Writing R functions is a useful skill to develop. It is not a good idea to try to type your functions directly into R unless they are very short. A good way proceed is to type your functions into an editor such as the **Notepad** accessory (I don't recommend **Word** because of the formatting it does) and then cutting and pasting into R. This makes revising them simpler.

- (a) Write a function which computes the (real) roots of the polynomial  $ax^2 + bx + c$ . The roots are given by:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Your program should first compute the *discriminant*  $\sqrt{b^2 - 4ac}$  and **if** this positive, compute and return the roots. If the discriminant is negative your function should **stop** with an error message.

Note that in R multiplication is denoted by “\*,” raising to a power by “^” and square roots can be obtained with the **sqrt** function.

- (b) Check that your function works by comparing its results with those obtained **polynom** package available for R. To use the **polynom** package you need to (once) type

```
library(polynom)
```

to get access to the package. Now you can carry out a variety of polynomial calculations. For example, to compute the roots of the polynomial  $2x^2 + 3x + 1$ :

```
p = polynomial(c(1,3,2))
solve(p)
```

(note that the coefficients are for ascending powers of  $x$ ).

You can obtain the polynomial with roots 1,2 and 3 as follows

```
p = poly.calc(c(1,2,3))
```

and then get information about it by typing:

```
summary(p)
```

You can get additional help about the polynomial library library by typing:

```
help(package=polynom)
?polynomial
```

etc.