

(PartII) Lab-session 1¹

1) Verify the following identity:

$$\sum_{a=1}^n (2a - 1)^3 = n^2(2n^2 - 1) \quad (1)$$

- a) Write three different versions of a function depending on n , which reproduces the left hand side of equation (1). Use for this the DO ... LOOP structure with the WHILE, UNTIL and EXIT DO commands.
- b) Write a function depending on n , which reproduces the right hand side of this equation.
- c) Use the Excel spreadsheet to verify that all four functions give the same result.

2) Approximate the following identity:

$$\sum_{n=1}^{\infty} (-1)^{(n+1)} \frac{x^n}{n} = \ln(1 + x) \quad \text{for } -1 < x \leq 1 \quad (2)$$

- a) Terminate the sum in (2) at some large value, say a , i.e. $\sum_{n=1}^{\infty} \rightarrow \sum_{n=1}^a$ and use the DO ... LOOP structure to write a function depending on a and x which approximates the left hand side of (2). The function should give out an error message, such as "The series does not converge for this value of x " when x is not in the range $-1 < x \leq 1$.
- b) Use the Excel spreadsheet to compute $\ln(1 + x)$ and verify the approximation.

3) Write a function depending on p , which involves a nested DO...LOOP structure and verify the identity

$$\sum_{k=1}^p \sum_{l=1}^k \sum_{m=1}^l m^2 = \frac{1}{120} p(1 + p)(2 + p)(3 + p)(3 + 2p) \quad (3)$$

in a similar way as in task 1.

4) DO...LOOP structures can also be used efficiently to fill in data into an Excel spreadsheet. To see this enter the subroutine "Fill" into the VBA editor (in much the same way as you would enter the code for a user defined function):

```
Sub Fill()  
  Range("A1").Select  
  m = 0  
  Do While m < 10  
    n = 0  
    Do While n < 10  
      ActiveCell.Offset(m, n).Value = (n + 1) * (m + 1)  
      n = n + 1  
    Loop  
  Loop
```

¹The lecture material and Lab sheets are available at:
<http://www.staff.city.ac.uk/o.castro-alvaredo/PROGRAMMING/programming.html>

$m = m + 1$

Loop

End Sub

As indicated above, a programme like this is called a subroutine or macro (both names are equivalent).

Once you have typed in the subroutine it can be activated as follows:

1. Select the “View” tab in your Excel workbook
2. Select the “Macros” option (on the upper right hand side corner)
3. Select *View Macro*
4. In the window that will then open you will have a list of all your Macros or Subroutines. You will probably only have the subroutine you just wrote “fill”. Select this subroutine and then click on the “run” button.

⇒ This will fill in 10 columns and rows with entries $\text{rownumber} * \text{columnnumber}$.

More on Macros and subroutines in the next lecture.