Computing and Statistical Data Analysis
Problem sheet 2

Remember to write your name, College and degree programme (e.g., PhD, MSci or MSc) on your paper.

Please turn in a copy of the source code and relevant sample output. Avoid unnecessarily complicated code. Highest marks go to a simple, elegant, robust solution. If you choose to do something complicated (e.g., fancy error checking), then the complexity should buy meaningful additional functionality or robustness.

1: Starting from the algorithm you created to compute factorials in Problem Sheet 1, write a function called `factorial` that takes a single `int` argument and returns the factorial as a `double`. Note that the error checking, e.g., for non-negative integer input, must now be put inside the body of the function.

Put the function in a separate file `factorial.cc` and put the prototype in a header file `factorial.h` with the appropriate "include guards".

Write a short `main` program to test your function (i.e., similar to the program from Problem Sheet 1).

Write a short shell script called, say, `build.sh` to compile and link the program.

Show sample output for a few values of the input value, e.g., $n = 10, 40, 80$.

Overload the `factorial` function so that it can also take an argument of type `double`, which also returns `double`. Illustrate the use of the function in the main program. (Hint: remember the "once and only once" principle.) The function definitions and prototypes can go into the same files as for the original.

2: Write a program that computes a table of values of n, $\sqrt{n}$, $\ln n$ and $n!$ for $n = 1, 2, \ldots n_{\max}$, where the value $n_{\max}$ is set by the user through a `cin` statement. Using the techniques shown in the lecture, display the result on the monitor formatted such that the value of n appears as an integer in a column with 5 spaces, the values of $\sqrt{n}$ and $\ln n$ appears as decimal values with 12 total spaces and five places to the right of the decimal point, and the value of $n!$ is given in scientific notation with five digits to the right of the decimal place.

Then using the methods described in the lectures, also write the table of numbers to an output file. Create the file for $n_{\max} = 20$.

3: Write a function `swap(x,y)` of return type `void` which takes two `int` arguments passed by reference, such that the values of `x` and `y` are swapped after calling the function. Write a short test program which calls `swap` to test and illustrate its use.

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