MATH 160S

# Mini-project: Identify the Impostors

Target due date: Tuesday, March 7, 2006

Project papers submitted after Thursday March 9 will be considered late.

NUMERICAL DIFFERENTIATION may be used to obtain information about data of unknown accuracy or quality, or about data from an unknown source. In my public html directory

`www.math.duke.edu/~layton/160S/CSI/`

you will find five files of data that correspond to functions $f_i$ ($i$ = 1, 2, 3, 4, 5) defined on $[0, 1]$; each file (D1, D2, D3, D4, and D5) may be down-loaded by affixing its name to the end of the directory named above (e.g., `www.math.duke.edu/~layton/160S/CSI/D1`) and then saving the file.

(a) Write a program that numerically approximates derivatives $f_i^{(n)}$ of these functions with error $O(h^2)$.

(b) Identify the functions $f_i$ by examining the results of successive applications of the numerical derivative. The identifications should include explicit formulas with explicit coefficients, where possible.

(c) Also, write a program that uses the trapezoidal rule to approximate $F_i^{+1}(x) = 1 + \int_0^x f_i(s)\, ds$ on $[0, 1]$, $F_i^{+2} = 1 + \int_0^x F_i^{+1}(s)\, ds$, etc.

(d) Can useful information be obtained by successive integrations? Why, or why not?

(e) Prepare a type-written report of your work, including programs, graphs, and a comprehensive analysis (in words) of your investigation. Use double-spacing and one-inch margins (the programs need not meet these format specifications).

(Hints: One of the functions $f_i$ is the exponential function. The others are impostors. One of the impostors is simulated experimental data. All impostors are to be identified as fully as practicable.)