ESO 208A; ESO 218

Computational methods in engineering

Assignment #1

Due date: August 14, 2013

1. The derivative of $f(x) = 1/(1-3x^2)$ is given by $\dfrac{6x}{(1-3x^2)^2}$

Evaluate the derivative of the function at x = 0.577? Try it using 3- and 4-digit arithmetic with chopping.

2. Use 5-digit arithmetic with chopping to determine the roots of the following equation:

$x^2 - 5000.002x + 10$

Compute percentage relative errors on your results.

3. Use zero- through fourth-order Taylor series expansions to predict *f*(2.5) for *f*(x) = ln (*x*). Using a base point at x = 1. Compute the true percentage relative error ε_t for each approximation.

4. Manning's formula for a rectangular channel can be written as

$$Q = \frac{1}{n}\frac{(BH)^{5/3}}{(B+2H)^{2/3}}\sqrt{S}$$

Where *Q* = flow (m^3/s), *n* = a roughness coefficient, *B* = width (m), *H* = depth (m), and *S* = slope. You are applying this formula to a stream where you know that the width = 20 m and the depth = 0.3 m. Unfortunately you know the roughness and the slope to only a $\pm$ 10% precision. That is, you know that the roughness is about 0.03 with a range from 0.027 to 0.033 and the slope is 0.0003 with a range from 0.00027 to 0.00033. Use a first-order error analysis to determine the sensitivity of the flow prediction to each of these two factors. Which one should you attempt measure with more precision?

5. Determine the real root of $f(x) = 4x^3 - 6x^2 + 7x - 2.3$ by using the following methods:

(a) Graphical method;

(b) The bisection method; Use initial guesses of $x_l = 0$ and $x_u = 1$ and iterate until the estimated error ε_a falls below a level of $\varepsilon_s = 10\%$.