ESO 208A: Computational Methods in Engineering

Tutorial 1

Truncation error and estimation of error bound

1.Use the second order Taylor series approximation of $f(x)=e^x\cos(x)$ at $x=0$ to :

i. Approximate the function values at $x = 0.5$ and $x = 1.0$

ii. Estimate the true error for both the approximations and compare them with the upper bound of truncation errors obtained from Taylor's theorem.

iii. Approximate $\int_0^1 f(x)\mathrm{d}x$ using Taylor's series. Determine an upper bound for the error and compare it with the true error.

Propagation of data error

2. Consider the expression $z = x^2y - xy^2$ where x and y are measured quantities used for estimating z. If the measured values of x and y are 3 and 2, respectively, and their measurement errors are $\delta x = \delta y = 0.1$,

i. Estimate error in z by using first order error analysis

ii. Recalculate error in z by second order analysis and comment on the usefulness of higher order error analysis.

3. The deflection of the top of the sailboat mast is given by

$$y = \frac{FL^4}{8EI}$$

where F = a uniform side loading (N/m), L=height (m), E= the modulus of elasticity (N/m^2) and I = the moment of inertia (m^4). Estimate the error in y given the following data.

F=750 N/m	$\Delta F = 30$ N/m
L=9 m	$\Delta L = 0.03$ m
E=7.5 x 10^9 N/m^2	$\Delta E = 5$ x 10^7 N/m^2
I= 0.0005 m^4	$\Delta I = 0.000005$ m^4