The University of Zambia
Department of Mathematics and Statistics
MAT 4119 - Engineering Mathematics III
Tutorial Sheet 5

2023

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1. Consider the table of data below

x	0.2	0.4	0.6	0.8	1.0
f(x)	0.9798652	0.9177710	0.8080348	0.6386093	0.3843735

   (a) Use all appropriate formulas to approximate $f'(0.4)$ and $f''(0.4)$.

   (b) Use all appropriate formulas to approximate $f'(0.6)$ and $f''(0.6)$.

2. Let $f(x) = x^3e^{x^2} - \sin x$. For $h = 0.1$ and $h = 0.01$, approximate $f'(2.19)$, using central difference formula and the three-point endpoint formula.

3. Let $f(x) = \cos \pi x$. Use the values of $f(x)$ at $x = 0.25, 0.75, 1.0$, $h = 0.01$, and the
   (a) approximation formula

$$f'(x_0) = \frac{1}{12h}[f(x_0 - 2h) - 8f(x_0 - h) + 8f(x_0 + h) - f(x_0 + 2h)] + \frac{h^4}{30}f^{(5)}(c),$$

   where $x_0 - 2h < c < x_0 + 2h$,
   (b) central difference formula

   to approximate $f'(0.5)$. Find a bound for the error in each case, and compare the results.

4. Suppose the following data has been experimentally collected.

x	1.00	1.01	1.02
f(x)	1.27	1.32	1.38

   (a) Use the centered difference formula and the three-point mid-point formula with step values $h = 0.1, 0.001$, to approximate
   (i) $f'(1.005)$ and $f'(1.015)$.

   (ii) $f''(1.01)$.
   (b) Find the maximum error in each case.