

King Fahd University of Petroleum and Minerals
College of Computer Sciences and Engineering

CISE 301 – Numerical Methods (T152)

Homework # 06 (due date & time: Sunday 03/04/2016 during class period)

*** Show all your work. No credit will be given if work is not shown! ***

Problem 1 (40 points): Use centered difference approximations of $O(h^4)$ to estimate the *first* and *second* derivatives for each of the following functions at the specified location and for the specified step size:

- (a) (20 points) $y = x^3 + 3x - 13$ at $x = 0, h = 0.25$
(b) (20 points) $y = x^2 \sin x$ at $x = 0.2$ (radian), $h = 0.1$

Problem 2 (30 points):

- (a) (25 points) Compute forward and backward difference approximations of $O(h)$ and $O(h^2)$, and central difference approximations of $O(h^2)$ and $O(h^4)$ for the first derivative of $y = e^x$ at $x = 0.1$ for $h = 0.2$.
(b) (5 points) Estimate the true percent relative error ϵ_t for each approximation.

Problem 3 (30 points): Consider the following data set:

X	0	2	3	3.5	4	4.5	5	6	7
$f(x)$	0.5	1	0.75	4	3.5	1.9	1.35	1	1.7

- (a) (25 points) Using a tabular form, determine the best estimate of the first order derivative of $f(x)$ at $x = 4$ using the Richardson extrapolation method with the highest accuracy possible. (Hint: Determine the appropriate h from the given data set)
(b) (5 points) Determine the order, in terms of h , of the truncation error of part (a).