

Assignment 4

- Write a program for **generalised least squares** and use it to fit the following data with the functions suggested. Plot the line as well as the points on a x-y plot and visualise.

x	0.03	0.17	0.31	0.44	0.56
y	0.00	2.50	5.00	7.50	10.0

$$\text{Function } y = mx + c$$

(b)

y	10.0	38.0	0.44	0.56
x	2.50	5.00	7.50	10.0

$$\text{Function } y = ax^n$$

Check for the dimensional and non-dimensional error values as discussed in the class.

- Using Newton's forward difference third order polynomial, evaluate the expressions for the first and second derivatives at the point $s = (x-x(i))/h$, using points $i, i+1, i+2$ and $i+3$, with function values being $f(i), f(i+1), f(i+2)$ and $f(i+3)$ for the following digital function at $x = 2.5$.

x	0	1	2	3	4	5	6	7	8	9	10
f	0	2	16	54	128	250	512	686	1024	1458	2000

Note that the function is $2 * x^{**3}$. Compare your answers with the exact solution and comment.

- Now generate values for a function using a fourth order polynomial of your choice with x varying from 0-10 as done in previous problem. Now find the values of the derivatives at $x = 5.5$ using third order forward interpolation. Now estimate the error using the error term and comment. (Note that you know the function and hence you can try to obtain the error term by taking a suitable intermediate point, ξ)
- Consider Romberg integration for a function $f(x)$. You are asked to write a computational procedure which will perform successive refinement till the accuracy reaches a desired value. The procedure will be to divide the interval into one strip and obtain the integral by trapezoidal rule. Then the interval is divided into two strips and the integral is reevaluated. Using these two values, the better approximation is obtained. This value and the value with the higher strips is compared to check the acceptability of the normalised error. If not acceptable the number of strips are doubled and the process repeated as discussed in the class. You may implement the procedure. You may limit the maximum level of Romberg to 15 Now use the procedure for the evaluation of

$$\int_0^{0.495\pi} \text{Sec}^2 \theta \, d\theta$$

With a normalised errors of 10^{-5} , 10^{-6} and 10^{-7} . Indicate as to how many levels were required. Make sure to tabulate the value given by directly evaluating the integral analytically and the use of your calculator.