MA322: Scientific Computing

Lab Assignment 5

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Q.3) There are 2 files as part of the solution.

i) l5_3_code.h : - The header file

ii) l5_3_main.cpp : - The testing file

The values of n, x_i, $f(x_i)$ are taken as user input.

a) For both even and odd number of nodes : - Simpson's 1/3rd and Simpson's 3/8th rules are combined to get a general rule for this case.

n = number of nodes

m = n % 3

1) If m = 0, the Simpson's 3/8th rule has been used for the first (n − 2) points and the Simpson's 1/3rd rule has been used for the last 3 points. Finally, the summation of the two parts gives us the answer.
2) If m = 1, the Simpson's 3/8th rule has been used for all the n points.
3) If m = 2, the Simpson's 3/8th rule has been used for the first (n − 4) points and the Simpson's 1/3rd rule has been used for the last 5 points. Finally, the summation of the two parts gives us the answer.

The following is the output : -

```
PS D:\Downloads\vs code programs\vs code programs> cd "d:\Downloads\vs code programs\vs code programs\" ; if ($
?) { g++ l5_3_main.cpp -o l5_3_main } ; if ($?) { .\l5_3_main }
Enter n
12
Enter x
1 2 3 4 5 6 7 8 9 10 11 12
Enter fx
3 6 9 12 15 18 21 24 27 30 33 36
I = 214.5
PS D:\Downloads\vs code programs\vs code programs>
```

b) For only odd number of nodes : - The Simpson's 1/3rd rule has been directly used.

The following is the output : -

```
PS D:\Downloads\vs code programs\vs code programs> cd "d:\Downloads\vs code programs\vs code programs\" ; if ($
?) { g++ l5_3_main.cpp -o l5_3_main } ; if ($?) { .\l5_3_main }
Enter n
7
Enter x
1 2 3 4 5 6 7
Enter fx
2 4 6 8 10 12 14
I = 48
PS D:\Downloads\vs code programs\vs code programs>
```

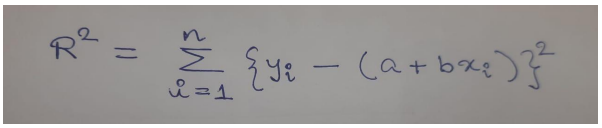
Q.4) There are 2 files as part of the solution.

i) l5_4_code.h : - The header file

ii) l5_4_main.cpp : - The testing file

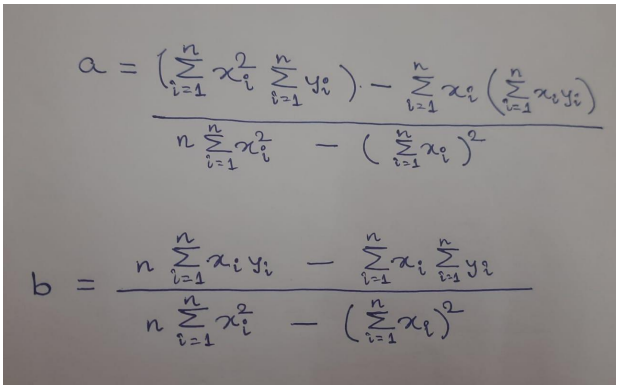
The values of n, x_i, y_i are taken as user input.

Given : -



$$R^2 = \sum_{i=1}^{n} \{y_i - (a + bx_i)\}^2$$

Solving the system of equations, we get the following : -



$$a = \frac{\left(\sum_{i=1}^{n} x_i^2 \sum_{i=1}^{n} y_i\right) - \sum_{i=1}^{n} x_i \left(\sum_{i=1}^{n} x_i y_i\right)}{n \sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}$$

$$b = \frac{n \sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n \sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2}$$

The following is the output : -

```
PS D:\Downloads\vs code programs\vs code programs> cd "d:\Downloads\vs code programs\vs code programs\" ; if ($
?) { g++ l5_4_main.cpp -o l5_4_main } ; if ($?) { .\l5_4_main }
Enter n
5
Enter x
10 20 40 50 60
Enter y
5 10 15 20 30
a = -0.116279
b = 0.447674
R^2 = 25.2907
f(x) = -0.116279 + 0.447674x
PS D:\Downloads\vs code programs\vs code programs>
```