###### **Programming Assignment 3:** Interpolation and Regression

1. Write a computer program for interpolation using Lagrange polynomials and natural cubic spline. The program should have the following features:

**Input:** The program should read - (i) the number of data points (*n*+1) and the input data points from a text file, and (ii) the number of points, *m*, and the corresponding abscissa, , where the value of *y* has to be estimated.

**Options:** The user should have the option of selecting one or more of the following methods–

1. Lagrange polynomials
2. Natural cubic spline

**Output:** The output from the program should be in the form of

1. A text file containing the values of *y* at
2. A figure showing the data points and the fitted polynomial
3. Write a computer program for polynomial least-squares fitting.

**Input:** The program should read the following inputs from a text file –

(i) the number of points (*n*+1), (ii) data points .

**Options:** The user should have an option of selecting the degree of polynomial

**Output:** The output from the program should be in the form of

1. A text file containing the coefficients of polynomials and coefficient of determination
2. A figure showing the data points and the fitted polynomial.

**Test Data, Problem 1:**

**Sample input file**

Input (*n*+1), *x* and *y*

5

-1.000 0.0385

-0.500 0.1379

0.000 1.0000

0.500 0.1379

1.000 0.0385

Number of points where function has to be evaluated, *m*, and values of *x*\*

4

-0.8000

-0.2000

0.2000

0.8000

**Sample output files**

Interpolated values *y* at given *x*\*

Lagrange Polynomials

-0.800 -0.3793

-0.200 0.8342

0.200 0.8342

0.800 -0.3793

Cubic spline

-0.800 -0.0363

-0.200 0.7716

0.200 0.7716

0.800 -0.0363

**Sample Figure**

**Test Data, Problem 2:**

**Sample input file**

20

|  |  |
| --- | --- |
| 0.051 | 0.687 |
| 0.073 | 0.983 |
| 0.089 | 0.857 |
| 0.798 | 9.997 |
| 0.943 | 18.345 |
| 0.684 | 6.233 |
| 0.132 | 0.994 |
| 0.723 | 6.805 |
| 0.11 | 0.845 |
| 0.117 | 1.278 |
| 0.641 | 4.622 |
| 0.329 | 1.633 |
| 0.654 | 5.462 |
| 0.749 | 7.621 |
| 0.583 | 4.249 |
| 0.74 | 7.61 |
| 0.235 | 0.935 |
| 0.735 | 7.564 |
| 0.971 | 20.224 |
| 0.867 | 12.94 |

**Sample output files**

Linear : coefficients -1.860 15.363

: R-sq = 0.761

Quadratic : coefficients 2.917 -22.466 40.109

: R-sq = 0.980

Cubic : coefficients 0.155 11.192 -36.585 47.596

: R-sq = 0.998

Quartic : coefficients 1.027 -3.744 28.959 -52.383 49.056

: R-sq = 0.999

**Sample Figure**

**Due date**: Friday, October 28, 2022, 11:59 pm. No assignments will be accepted over email).

Submit a **single zip folder** in the Brihaspati server under Assignment3. The name of the zip-folder should be your roll-number (e.g., If your roll no. is 123456, the folder name should be '123456.zip'). The folder should include -

1. All the computer program file(s)
2. A PDF file of the solution and the required figures for the test cases given in the assignment.