

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 $(x_k, y_k), k = 0, 1, 2, \dots, n$ from a text file, and (ii) the number of points, m , and the corresponding abscissa, $x_i^*, i = 1, 2, \dots, m$, 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–
a. Lagrange polynomials
b. Natural cubic spline

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

- (a) A text file containing the values of y at x_i^*
- (b) A figure showing the data points and the fitted polynomial

2. 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 $(x_k, y_k), k = 0, 1, 2, \dots, n$.

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

- (a) A text file containing the coefficients of polynomials and coefficient of determination
- (b) 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

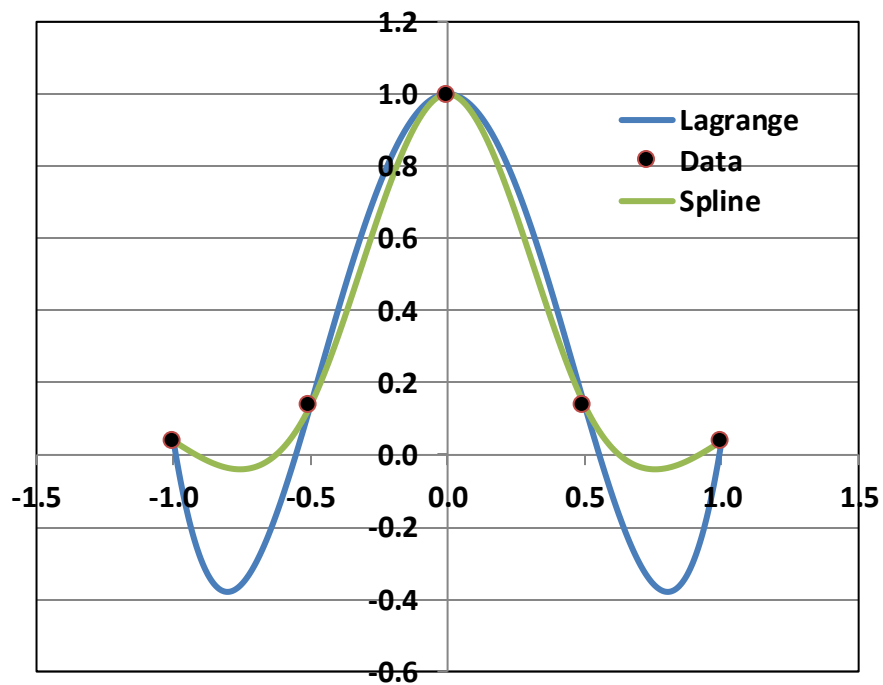
-0.800 -0.0363

-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

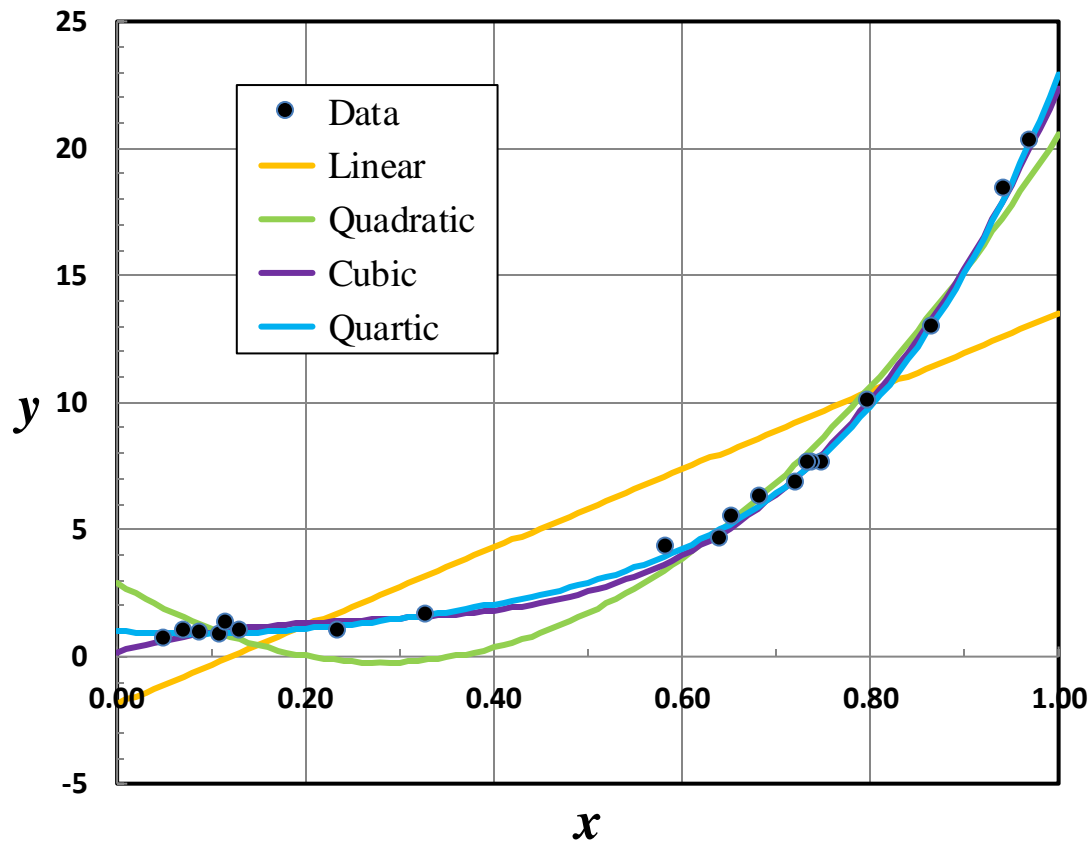
Linear : coefficients -1.860 15.363
 : R-sq = 0.761

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 -

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