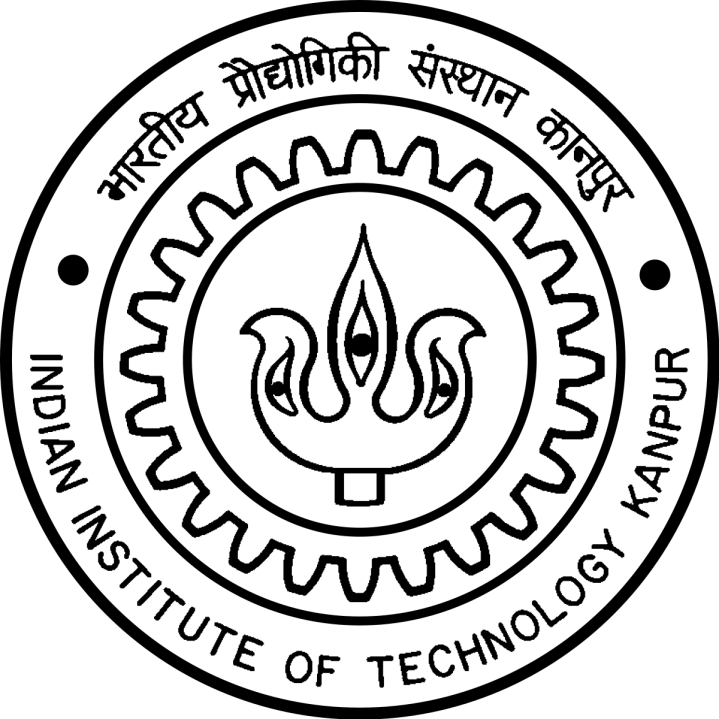
**ESO-208A**

**Computational Methods in Engineering**



Programming Assignment – 3

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**Prob 6**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **X** | **0.2** | **0.4** | **0.6** | **0.8** | **1** |
| **Y** | **2** | **3** | **3.8** | **4.4** | **4.8** |

1. **Lagrange Interpolation**

-4.263256e-14 1.705303e-13 -2.500000e+00 6.500000e+00 8.000000e-01 

1. **Least Square without zero intercept**

6.5\*x - 2.5\*x^2 + 0.80000000000291038304567337036133

r^2 is : 1.000000



1. **Least Square With zero intercept**

9.3695652172900736331939697265625\*x - 4.6739130434580147266387939453125\*x^2

r^2 is : 0.972395



1. **Natural Spline**

-5.357143e+00 ; 3.214286e+00 ; 4.571429e+00 ;1

1.785714e+00 ; -5.357143e+00 ; 8.000000e+00 ; 5.428571e-01

-1.785714e+00 ; 1.071429e+00 ; 4.142857e+00 ;1.314286e+00

5.357143e+00 ; -1.607143e+01 ;1.785714e+01 ; -2.342857e+00

first derivatives -> 5.214286e+00 ; 4.571429e+00 ; 3.500000e+00 ; 2.428571e+00 ; 1.785714e+00

Second derivatives -> 0 ; -6.428571e+00 ; -4.285714e+00 ; -6.428571e+00 0



1. **Periodic Spline**

3.286260e-14 ; -2.500000e+00 ;6.500000e+00 ; 8.000000e-01

1.598721e-14 ; -2.500000e+00 ; 6.500000e+00 ;8.000000e-01

-4.884981e-14 ; -2.500000e+00 ; 6.500000e+00 ;8.000000e-01

3.286260e-14 ; -2.500000e+00 ;6.500000e+00 ;8.000000e-01

first derivatives -> 5.500000e+00 ; 4.500000e+00 ; 3.500000e+00 ; 2.500000e+00 1.500000e+00

Second derivatives -> -5.000000e+00 ; -5.000000e+00 ; -5.000000e+00 ; -5.000000e+00 ; -5.000000e+00



1. **Not A Knot Spline**

1.865175e-14 ; -2.500000e+00 ; 6.500000e+00 ; 8.000000e-01

1.687539e-14 ; -2.500000e+00 ; 6.500000e+00 ; 8.000000e-01

-3.463896e-14 ; -2.500000e+00 ; 6.500000e+00 ; 8.000000e-01

-3.108624e-14 ; -2.500000e+00 ; 6.500000e+00 ; 8.000000e-01

first derivatives -> 5.500000e+00 ; 4.500000e+00 ; 3.500000e+00 ; 2.500000e+00 ; 1.500000e+00

Second derivatives -> -5.000000e+00 ; -5 -5.000000e+00 ; -5.000000e+00 ; -5.000000e+00

****

1. **Clamped Spline**

-100 ; 1.050000e+02 ; -30 ; 4.600000e+00

2.500000e+01 ; -4.500000e+01 ; 3.000000e+01 ; -3.400000e+00

-6.257103e-14 ; 1.253015e-13 ; 3.000000e+00 ; 2.000000e+00

-2.500000e+01 ; 6.000000e+01 ; -4.500000e+01 ; 1.480000e+01

first derivatives -> 0 6.000000e+00 ; 3.000000e+00 ; 3.000000e+00 ; 0

Second derivatives -> 90 -3.000000e+01 ; 2.534725e-14 ; -4.973799e-14 ; -3.000000e+01



**Prob 8**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **X** | **1** | **2** | **3** | **4** | **5** |
| **Y** | **7.7** | **16** | **27.2** | **40.9** | **61.1** |

1. **Lagrange Interpolation**

8.266666666604578495025634765625\*x^2 - 5.9499999999534338712692260742188\*x - 1.8999999999941792339086532592773\*x^3 + 0.18333333333430346101522445678711\*x^4 + 7.0999999999767169356346130371094 

1. **Least Square with zero intercept**

4.925962732871\*x + 1.4198757763952\*x^2

r^2 is : 0.996951



1. **Least Square Without zero intercept**

1.8985714285809081047773361206055\*x + 1.878571428562281653285026550293\*x^2 + 4.2199999999720603227615356445312

r^2 is : 0.999119



1. **Natural Spline**

7.142857e-01 ; -2.142857e+00 ; 9.728571e+00 ; -6.000000e-01

-6.714286e-01 ; 6.171429e+00 ; -6.900000e+00 ; 1.048571e+01

1.571429e+00 ; -1.401429e+01 ; 5.365714e+01 ; -5.007143e+01

-1.614286e+00 ; 2.421429e+01 ; -9.925714e+01 ; 1.538143e+02

first derivatives -> 7.585714e+00 ; 9.728571e+00 ; 1.200000e+01 ; 1.697143e+01 ; 2.181429e+01

Second derivatives -> 0 ; 4.285714e+00 ;2.571429e-01 ; 9.685714e+00 ;0



1. **Periodic Spline**

-1.200000e+00 ; 8.116667e+00 ; -7.650000e+00 ; 8.433333e+00

-1.333333e-01 ; 1.716667e+00 ; 5.150000e+00 ; -1.000000e-01

1.333333e+00 ; -1.148333e+01 ; 4.475000e+01 ; -3.970000e+01

-1.200000e+00 ; 1.891667e+01 ; -7.685000e+01 ; 1.224333e+02

first derivatives -> 4.983333e+00 ; 1.041667e+01 ; 1.185000e+01 ; 1.688333e+01 2.231667e+01

Second derivatives -> 9.033333e+00 ; 1.833333e+00 ; 1.033333e+00 ; 9.033333e+00 ; 1.833333e+00



1. **Not A Knot Spline**

-2.500000e-01 ; 2.950000e+00 ; 1.200000e+00 ; 3.800000e+00

-2.500000e-01 ; 2.950000e+00 ; 1.200000e+00 ; 3.800000e+00

8.500000e-01 ; -6.950000e+00 ; 3.090000e+01 ;-2.590000e+01

8.500000e-01 ; -6.950000e+00 ; 3.090000e+01 ; -2.590000e+01

first derivatives -> 6.350000e+00 ; 10 1.215000e+01 ; 1.610000e+01 ; 2.515000e+01

Second derivatives -> 4.400000e+00 ; 2.900000e+00 ; 1.400000e+00 ; 6.500000e+00 ; 1.160000e+01

****

1. **Clamped Spline**

-4.450000e+00 ; 2.610000e+01 ; -3.885000e+01 ; 2.490000e+01

-3.500000e-01 ; 1.500000e+00 ; 1.035000e+01 ; -7.900000e+00

5.450000e+00 ; -5.070000e+01 ; 1.669500e+02 ; -1.645000e+02

-1.745000e+01 ; 2.241000e+02 ; -9.322500e+02 ; 1.301100e+03

first derivatives -> 0 ; 1.215000e+01 ; 9.900000e+00 ; 2.295000e+01 ; 0

Second derivatives -> 2.550000e+01 ; -1.200000e+00 ; -3.300000e+00 ; 2.940000e+01 ; - 7.530000e+01



**Prob 10**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **X** | **0** | **2** | **4** | **8** |
| **Y** | **1** | **0.7937** | **0.6300** | **0.3968** |

1. **Lagrange Interpolation**

0.0063750000000482032191939651966095\*x^2 - 0.11520000000018626451492309570312\*x - 0.00017499999999870397004997357726097\*x^3 + 1.0 

1. **Least Square with zero intercept**

0.3571821782170445658266544342041\*x - 0.038906683168534073047339916229248\*x^2

r^2 is : -4.560598 

1. **Least Square Without zero intercept**

0.0043704545454374965629540383815765\*x^2 - 0.11021090909162012394517660140991\*x + 0.99908363635768182575702667236328

r^2 is : 0.999948



1. **Natural Spline**

1.133152e-03 ; 0 ; -1.076826e-01 ; 1

-3.407609e-04 ; 8.843478e-03 ; -1.253696e-01 ; 1.011791e+00

-3.961957e-04 ; 9.508696e-03 ; -1.280304e-01 ; 1.015339e+00

first derivatives -> -1.076826e-01 ; -9.408478e-02 ; -7.097826e-02 ; -5.196087e-02

Second derivatives -> 0 ; 1.359783e-02 ; 9.508696e-03 ; 0



1. **Periodic Spline**

5.982955e-04 ; 3.518182e-03 ; -1.125795e-01 ; 1

-5.982955e-04 ; 1.069773e-02 ; -1.292841e-01 ; 1.014264e+00

2.991477e-04 ; -7.159091e-05 ; -9.094545e-02 ; 9.757818e-01

first derivatives -> -1.125795e-01 ; -9.367273e-02 ; -7.715909e-02 ; -3.465455e-02

Second derivatives -> 7.036364e-03 ; 1.421591e-02 ; 7.036364e-03 ; 1.421591e-02



1. **Not A Knot Spline**

-1.750000e-04 ; 6.375000e-03 ; -1.152000e-01 ; 1

-1.750000e-04 ; 6.375000e-03 ; -1.152000e-01 ; 1

-1.750000e-04 ; 6.375000e-03 ; -1.152000e-01 ; 1

first derivatives -> -1.152000e-01 ; -9.180000e-02 ; -7.260000e-02 ; -4.680000e-02

Second derivatives -> 1.275000e-02 ; 1.065000e-02 ; 8.550000e-03 ; 4.350000e-03

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1. **Clamped Spline**

2.130227e-02 ; -9.417955e-02 ; -2.775558e-17 ; 1

-7.006818e-03 ; 7.567500e-02 ; -3.397091e-01 ; 1.226473e+00

2.872727e-03 ; -4.287955e-02 ; 1.345091e-01 ; 5.941818e-01

first derivatives -> -2.775558e-17 ; -1.210909e-01 ; -7.063636e-02 ; 6.938894e-18

Second derivatives -> -1.883591e-01 ; 6.726818e-02 ; -1.681364e-02 ; 5.213182e-02



**Prob 11**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **X** | **1** | **2** | **3** | **5** | **6** |
| **Y** | **1** | **12** | **54** | **375** | **756** |

1. **Lagrange Interpolation**

0.5\*x^3 - 0.000000000000227373675443232059478759765625\*x + 0.5\*x^4

1. **Least Square with zero intercept**

31.949655766133219003677368164062\*x^2 - 72.62693631649017333984375\*x

r^2 is : 0.980729



1. **Least Square Without zero intercept**

43.54220779240131378173828125\*x^2 - 162.0551948063075542449951171875\*x + 137.45454545319080352783203125

r^2 is : 0.992425



1. **Natural Spline**

4.436567e+00 ; -1.330970e+01 ; 1.987313e+01 ; -10

8.817164e+00 ; -3.959328e+01 ; 7.244030e+01 ; -4.504478e+01

1.064366e+01 ; -5.603172e+01 ; 8.721455e+01 ; 9.263060e+00

-3.454104e+01 ; 6.217388e+02 ; -3.314892e+03 ; 5.723619e+03

first derivatives -> 6.563433e+00 ; 1.987313e+01 ; 3.840299e+01; 3.119179e+02 ; 4.155410e+02

Second derivatives -> 0 ; 2.661940e+01 ; 7.952239e+01 ; 2.072463e+02 ; 0



1. **Periodic Spline**

-3.977692e+01 ; 2.245846e+02 ; -3.843154e+02 ; 2.005077e+02

1.937692e+01 ; -1.303385e+02 ; 3.255308e+02 ; -2.727231e+02

1.020000e+01 ; -4.774615e+01 ; 4.266923e+01 ; 8.030769e+01

-3.977692e+01 ; 7.019077e+02 ; -3.720285e+03 ; 6.400846e+03

first derivatives -> -5.447692e+01 ; 3.670000e+01 ; 3.159231e+01 ; 3.155231e+02 ; 4.067000e+02

Second derivatives -> 2.105077e+02 ; -2.815385e+01 ; 8.810769e+01 ; 2.105077e+02 ; -2.815385e+01



1. **Not A Knot Spline**

4.571429e+00 ; -1.192857e+01 ; 1.478571e+01 ; -6.428571e+00

4.571429e+00 ; -1.192857e+01 ; 1.478571e+01 ; -6.428571e+00

8.857143e+00 ; -5.050000e+01 ; 1.305000e+02 ; -1.221429e+02

8.857143e+00 ; -5.050000e+01 ; 1.305000e+02 ; -1.221429e+02

first derivatives -> 4.642857e+00 ; 2.192857e+01 ; 6.664286e+01 ; 2.897857e+02 ; 4.810714e+02

Second derivatives -> 3.571429e+00 ; 31 ; 5.842857e+01 ; 1.647143e+02 ; 2.178571e+02

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1. **Clamped Spline**

8.714844e+00 ; -2.385938e+01 ; 2.157422e+01 ; -5.429688e+00

-1.714453e+01 ; 1.312969e+02 ; -2.887383e+02 ; 2.014453e+02

4.259180e+01 ; -4.063301e+02 ; 1.324143e+03 ; -1.411436e+03

-3.067734e+02 ; 4.834148e+03 ; -2.487825e+04 ; 4.225922e+04

first derivatives -> 0 3.071484e+01 ; 3.614063e+01 ; 4.552266e+02 ; 0

Second derivatives -> 4.570313e+00 ; 5.685938e+01 ; -4.600781e+01 ; 4.650938e+02 ; -1.375547e+03

