INDIAN INSTITUTE OF TECHNOLOGY GANDHINAGAR

MA 202: MATHEMATICS - IV
Semester–II, Academic Year 2022-23

Tutorial Set -3
Question - 1

By

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➔ In question 1, we are asked to estimate the value of specific volume at temperature equal to 750F by nth order polynomial interpolation. I have used the Lagrange Interpolation method. For nth order polynomial interpolation, we need (n+1) data points $(x_1,y_1),....,(x_{n+1},y_{n+1})$ We are given input data points as shown below.

T (°F)	v (ft^3/lb$_m$)
700	0.0977
720	0.12184
740	0.14060
760	0.15509
780	0.16643

- ➔ The idea behind the interpolation is to interpret a polynomial which takes on certain values at arbitrary points. Approximation for Lagrange Interpolation method, as we know, is given by:

Lagrange Polynomial:

$$p(x) = L_1(x)y_1 + L_2(x)y_2 + L_3(x)y_3 + \ldots L_N(x)y_N$$

$$L_k(x) = \frac{(x-x_1)(x-x_2)\ldots(x-x_{k-1})(x-x_{k+1})\ldots(x-x_N)}{(x_k-x_1)(x_k-x_2)\ldots(x_k-x_{k-1})(x_k-x_{k+1})\ldots(x_k-x_N)}$$

Numerator of $L_k(x)$ is product of all $(x - x_i)$ except for $(x - x_k)$
Denominator of $L_k(x)$ is product of all $(x_k - x_i)$ except for $(x_k - x_k)$

- ➔ Here, we need to estimate the value for 1 to nth order polynomial interpolation. I took two inputs- one is the value of n in which order of polynomial we need to estimate and the second is t(value of temperature where we need to estimate the value of volume.)

```
function v = T31_20110131(N,t)
% Given data
T = [700,720,740,760,780];
% to print the value of x_r up to long decimal digits
format('long')
n = size(T);
n = n(2);                       % Define n as a number of column
% Given data
V = [0.0977,0.12184,0.14060,0.15509,0.16643];
% Define a zero row matrix-(1*n)
L = zeros(1,n);
p=1;
q=1;
% Run the iterations of Interpolatrion method
for i=1:N
    for j=1:N
        if i == j
            continue;
        else
            p = p * (t - T(j));
            q = q * (T(i) -T(j));
        end
    end
    L(1,i) = V(i) * (p/q);
    p=1;
    q=1;
end
v=0;
for k=1:N
    v = v + L(1,k);
```

Code of the Lagrange Interpolation Method

➔ As we can see that we can find the value of volume by increasing the value of n. If we increase the value of n then we can estimate the more accurate value because by doing this, our estimated curve gets more overlap to the actual curve.

```
>> v = T31_20110131(1,750)

v =

   0.097700000000000

>> v = T31_20110131(2,750)

v =

   0.158050000000000

>> v = T31_20110131(3,750)

v =

   0.147962500000000

>> v = T31_20110131(4,750)

v =

   0.148309375000000

>>
```

Simulated Output