DELHI TECHNOLOGICAL UNIVERSITY

SCIENTIFIC COMPUTING (MC-204)

PRACTICAL FILE

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EXPERIMENT 5

AIM

Write the MATLAB program of Newton's Divided difference table and value of function of given any data set.

THEORY

NEWTON'S DIVIDED DIFFERENCE METHOD

The divided difference $f[x_0, x_1, x_2, \ldots, x_n]$, sometimes also denoted $[x_0, x_1, x_2, \ldots, x_n]$ (Abramowitz and Stegun 1972), on $n+1$ points x_0, x_1, ..., x_n of a function $f(x)$ is defined by $f[x_0] \equiv f(x_0)$ and

$$f[x_0, x_1, \ldots, x_n] = \frac{f[x_0, \ldots, x_{n-1}] - f[x_1, \ldots, x_n]}{x_0 - x_n} \quad (1)$$

for $n \geq 1$. The first few differences are

$$f[x_0, x_1] = \frac{f_0 - f_1}{x_0 - x_1} \quad (2)$$

$$f[x_0, x_1, x_2] = \frac{f[x_0, x_1] - f[x_1, x_2]}{x_0 - x_2} \quad (3)$$

$$f[x_0, x_1, \ldots, x_n] = \frac{f[x_0, \ldots, x_{n-1}] - f[x_1, \ldots, x_n]}{x_0 - x_n}. \quad (4)$$

Defining

$$\pi_n(x) \equiv (x - x_0)(x - x_1) \cdots (x - x_n) \quad (5)$$

and taking the derivative

$$\pi_n'(x_k) = (x_k - x_0) \cdots (x_k - x_{k-1})(x_k - x_{k+1}) \cdots (x_k - x_n) \quad (6)$$

gives the identity

$$f[x_0, x_1, \ldots, x_n] = \sum_{k=0}^{n} \frac{f_k}{\pi_n'(x_k)}. \quad (7)$$

Consider the following question: does the property

$$f[x_1, x_2, \ldots, x_n] = h(x_1 + x_2 + \ldots + x_n) \quad (8)$$

for $n \geq 2$ and $h(x)$ a given function guarantee that $f(x)$ is a polynomial of degree $\leq n$? Aczél (1985) showed that the answer is "yes" for $n = 2$, and Bailey (1992) showed it to be true for $n = 3$ with differentiable $f(x)$. Schwaiger (1994) and Andersen (1996) subsequently showed the answer to be "yes" for all $n \geq 3$ with restrictions on $f(x)$ or $h(x)$. Act

SOURCE CODE

```
clear all;
```

```
close all;

%sample data set taken
X=[3,6,12,19,23,27];
Y=[7,11,30,40,47,60];
size=6;

disp("The values of x:")
disp(X)
disp("The values of f(x):")
disp(Y)

num= input("Enter the value of x: ");

%calculating nebula of the function
nebf = zeros(size, size);
nebf(:, 1) = Y';
for j = 2 : size
    for i = 1 : (size - j + 1)
        nebf(i,j) = (nebf(i + 1, j - 1) - nebf(i, j - 1)) / (X(i + j - 1) -
X(i));
    end
end

%calculating the value of the function
sum=0;
for i=1:size
    multi=1;
    for j=1:i-1
        multi=multi*(num-X(j));
    end
    sum=sum + multi*nebf(1,i);
end

fprintf("The value of f(x) : %f",sum)
```

OUTPUT

```
>> newton_divided_difference
The values of x:
     3     6    12    19    23    27

The values of f(x):
     7    11    30    40    47    60

Enter the value of x:
17
The value of f(x) : 37.865146
```