

ASSIGNMENT: -05

EECE: -212

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Level: 2

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Here are some mathematical problem are solved by MATLAB 2020a. according to the questions. The answers are given bellow:

Question:

$(x, y) = (1, -15.997), (2, -19.808), (3, -21.813), (4, -15.712), (5, 14.875), (6, 103.968), (7, 312.947)$ Find the first and second derivative of the interpolated curve at $x = 6$ and $x = 7$. Use backward difference method.

Solution:

Here given some value of a function $f(x) = 0.003x^6 - 4x - 12$ against the value of x . Now I have to find the 1st derivative and 2nd derivative of the interpolated curve at $x=6$ & $x=7$. The programs are given bellow.

When $x=6$:

The image shows a MATLAB Editor window with a script named 'ex5_1.m' and a Command Window displaying the results. The script defines a function $f(x) = 0.003x^6 - 4x - 12$ and calculates the first and second derivatives of the interpolated curve at $x=6$ and $x=7$ using the backward difference method.

```

1 clc
2 clear all;
3 close all;
4 %the function is f(y)= 0.003 x^6 -4x -12;
5 x=[1:7];
6 y=[-15.997 -19.808 -21.813 -15.712 14.875 103.968 312.947];
7 d=length(x);
8
9 table= zeros(d,d+1);
10 table(:,1)=x;
11 table(:,2)=y;
12
13 for i=3:d+1
14     for j=d:-1:i-1
15         table(j,i)=table(j,i-1)-table(j-1,i-1);
16     end
17 end
18
19 %1st derivative diff(y)= 0.003*6*x^5-4
20 derivative1=0;
21 for i=1:6
22     derivative1=derivative1+ table(6,i+2)/i;
23 end
24
25 table
26 %2nd derivative diff(diff(y))=0.003*6*5*x^4
27 derivative2= table(6,4)+table(6,5)+(11/12)*table(6,6)+(5/6)*table(6,7)+0.7611*table(6,8);
28 derivative1
29 derivative2

```

The Command Window displays the following results:

```

table =

    1.0000   -15.9970     0     0     0     0     0     0
    2.0000   -19.8080   -3.8110     0     0     0     0     0
    3.0000   -21.8130   -2.0050    1.8060     0     0     0     0
    4.0000   -15.7120    6.1010    8.1060    6.3000     0     0     0
    5.0000    14.8750   30.5870   24.4860   16.3800   10.0800     0     0
    6.0000   103.9680   89.0930   58.5060   34.0200   17.6400    7.5600     0
    7.0000   312.9470   208.9790   119.8860   61.3800   27.3600    9.7200    2.1600

derivative1 =

    135.6080

derivative2 =

    114.9960
fx >>

```

Here,

1st derivative is 135.6080

2nd derivative is 114.9960

Here point to be noted that in backward function, in the decreasing of the value of x the accuracy of the value is also decreased.

So, when $x=6$

The value of 1st derivate is 135.6080.

But,

The accurate value is:

$\text{diff}(.003*x^6-4*x-12);$

$= 0.003*6*x^5-4$

$=135.968.$

The accuracy is: $\frac{135.6080}{135.968} \times 100 = 99.73\%$

Again, the value of 2nd derivative is 114.9960.

But,

The accurate value is:

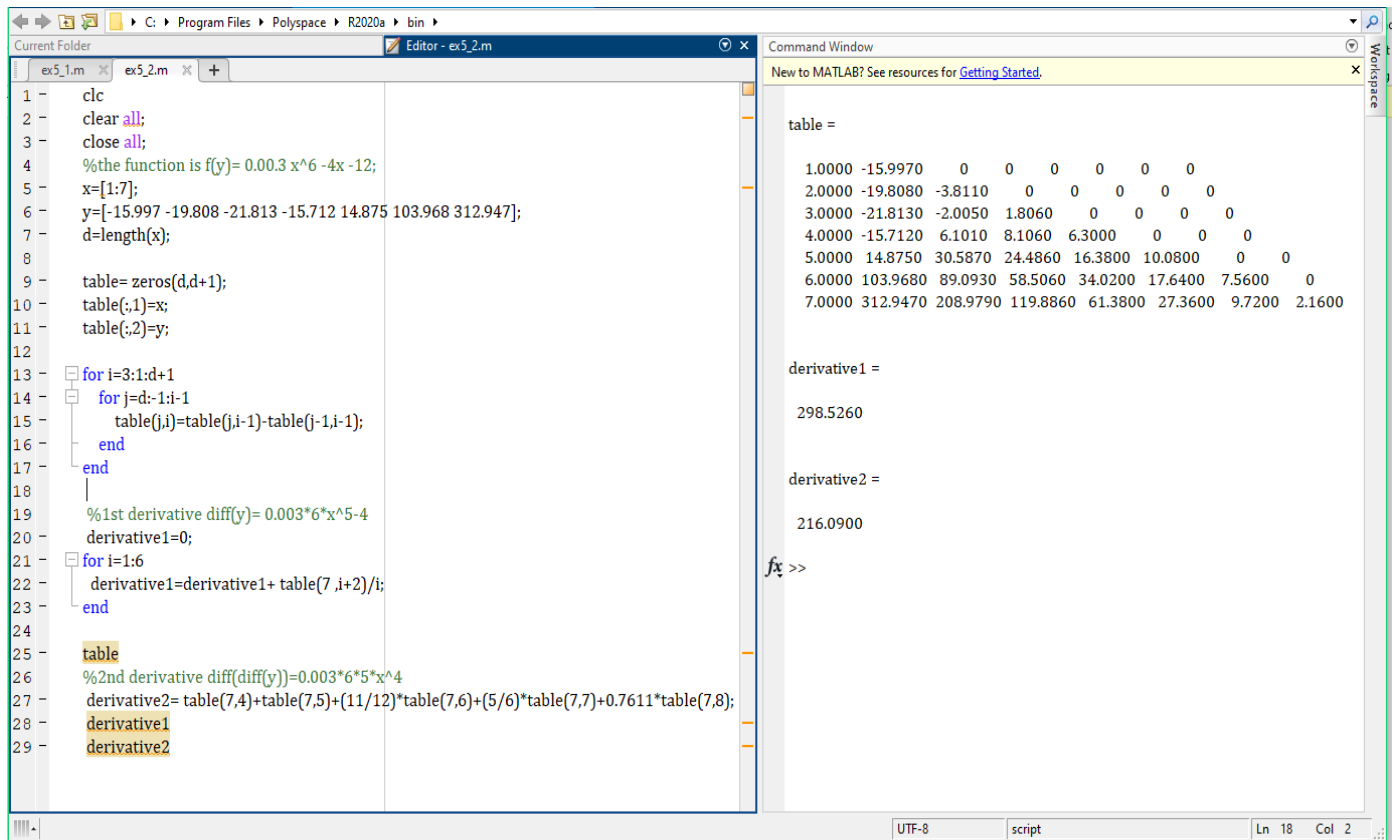
$\text{diff}(\text{diff}(0.003 x^6 -4x -12))$

$=0.003*6*5*x^4$

$=116.64$

The accuracy is: $\frac{114.9960}{116.64} \times 100 = 98.59\%$

When x=7:



The image shows a MATLAB script in the Editor window and its output in the Command Window. The script calculates the first and second derivatives of a function $f(x) = 0.003x^6 - 4x - 12$ at $x=7$ using a backward difference method. The script defines a table of values for x and y , and then calculates the derivatives using a loop and a formula for the second derivative.

```
1 clc
2 clear all;
3 close all;
4 %the function is f(y)= 0.003 x^6 -4x -12;
5 x=[1:7];
6 y=[-15.997 -19.808 -21.813 -15.712 14.875 103.968 312.947];
7 d=length(x);
8
9 table= zeros(d,d+1);
10 table(:,1)=x;
11 table(:,2)=y;
12
13 for i=3:1:d+1
14     for j=d:-1:i-1
15         table(j,i)=table(j,i-1)-table(j-1,i-1);
16     end
17 end
18
19 %1st derivative diff(y)= 0.003*6*x^5-4
20 derivative1=0;
21 for i=1:6
22     derivative1=derivative1+ table(7,i+2)/i;
23 end
24
25 table
26 %2nd derivative diff(diff(y))=0.003*6*5*x^4
27 derivative2= table(7,4)+table(7,5)+(11/12)*table(7,6)+(5/6)*table(7,7)+0.7611*table(7,8);
28 derivative1
29 derivative2
```

The Command Window shows the output of the script:

```
table =
    1.0000 -15.9970     0     0     0     0     0     0
    2.0000 -19.8080 -3.8110     0     0     0     0     0
    3.0000 -21.8130 -2.0050  1.8060     0     0     0     0
    4.0000 -15.7120  6.1010  8.1060  6.3000     0     0     0
    5.0000  14.8750  30.5870  24.4860  16.3800  10.0800     0     0
    6.0000 103.9680  89.0930  58.5060  34.0200  17.6400   7.5600     0
    7.0000 312.9470 208.9790 119.8860  61.3800  27.3600   9.7200   2.1600

derivative1 =
    298.5260

derivative2 =
    216.0900

fx >>
```

Here,

1st derivative is 298.5260

2nd derivative is 216.0900

As $x=7$ is the last value of backward function so it is fully accurate is the program value.