ASSIGNMENT:-4

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:

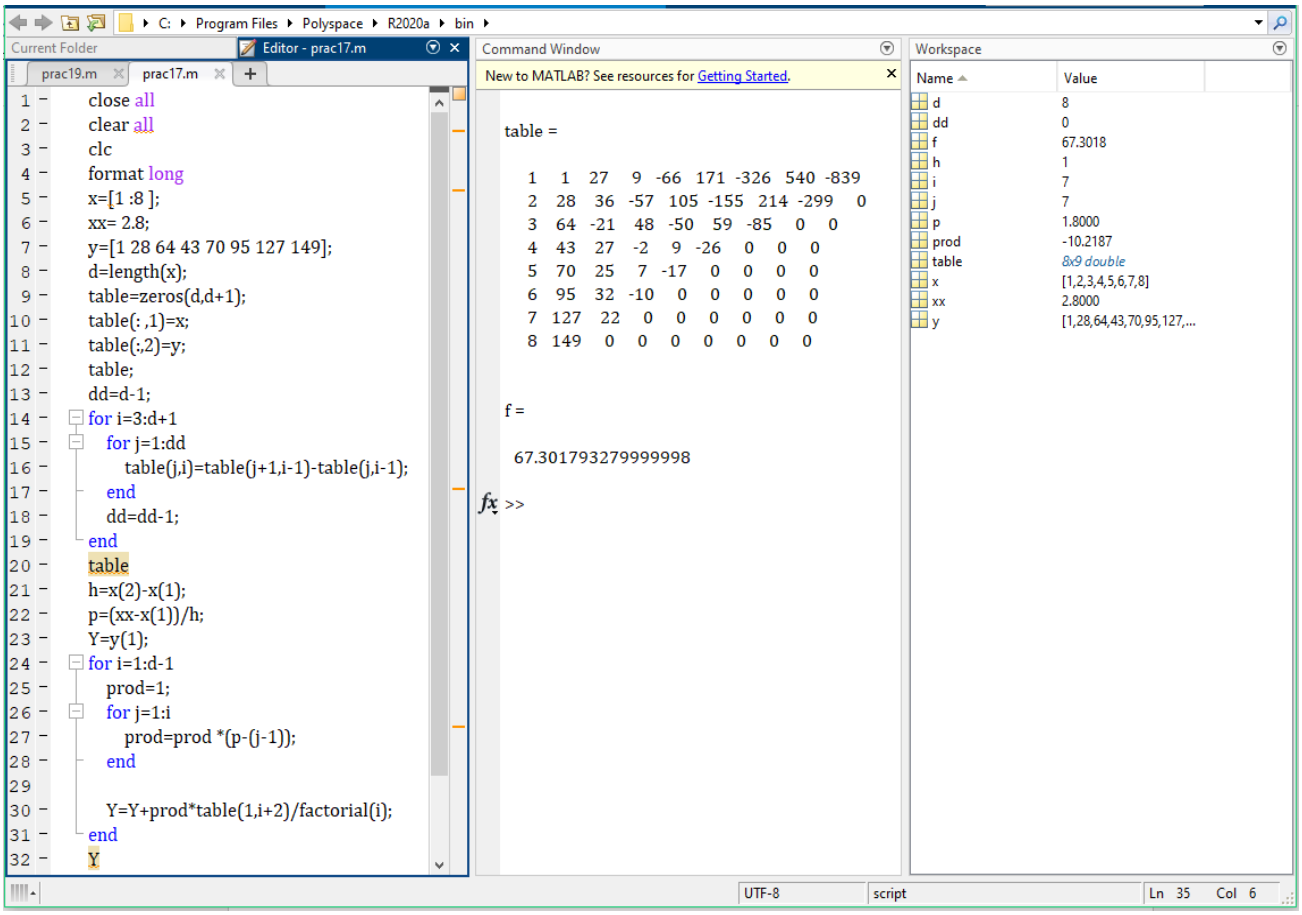
1. **For a system, following values of x and corresponding values of y are given: (1,1),(2,28),(3,64),(4,43),(5,70),(6,95),(7,127),(8,149) . Find the value of y when x=2.8 and x=7.7 using Newton's Forward and Backward Difference Interpolation Formula in Matlab.**

Solution:

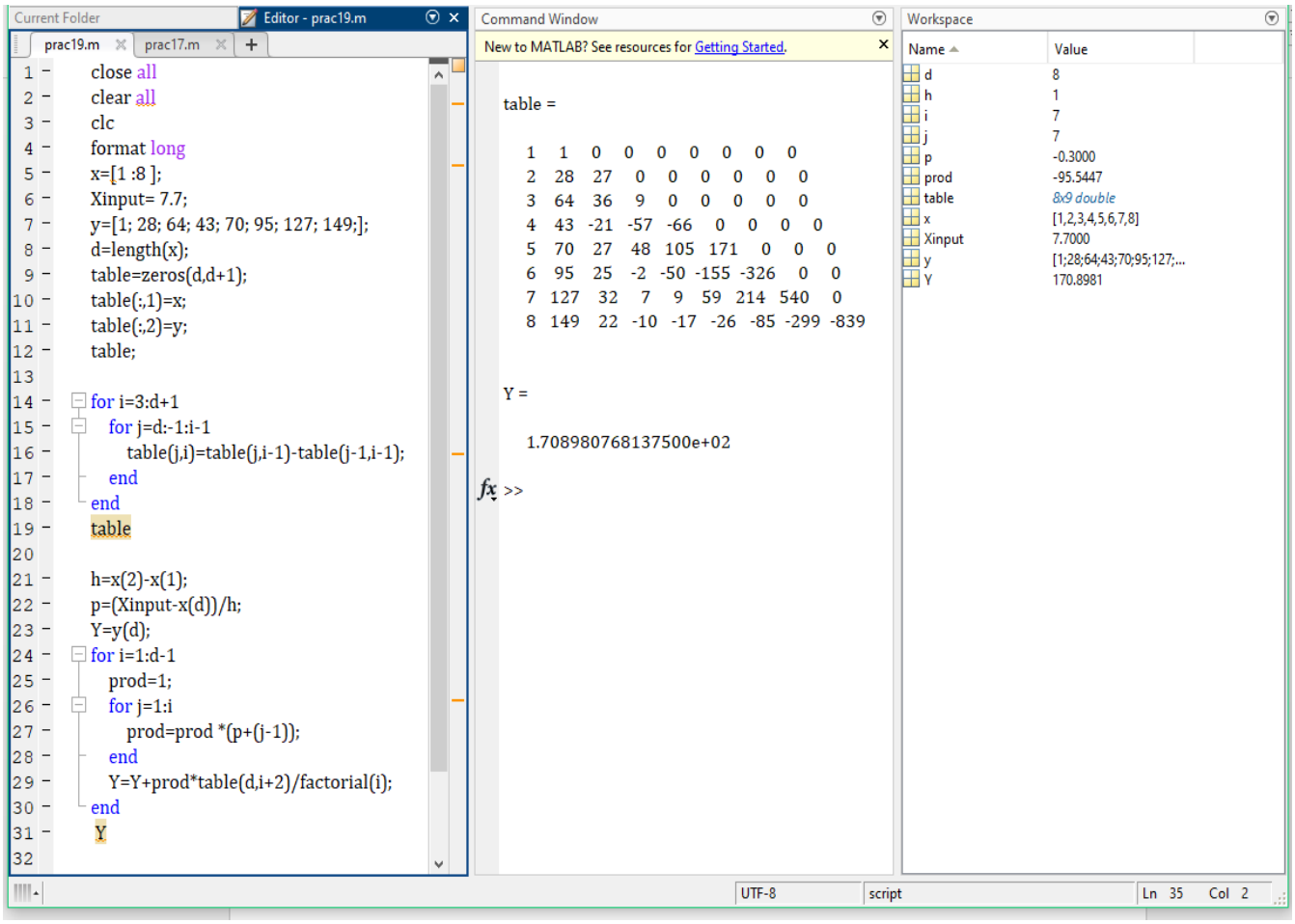
Here wanted to about the value of y when x=2.8 & x=7.7 using Newton's Forward and Backward Difference Interpolation Formula in Matlab.

Now using,

Forward method for x=2.8.



Backward method for x=7.7:



The value,

Y= 67.301793279999998; [when X=2.8]

Y= 1.708980768137500e+02; [when x=7.7]

2. Solve the above problem by hand calculation.

Solution:

Here have to write down the hand calculation of the following function equation. First its done by **newton forward method**. When **x=2.8.**

So the equation for newton forward method is:

$$y_n(x) = y_o + p\Delta y_o + \frac{p(p-1)}{2!}\Delta^2 y_0 + \frac{p(p-1)(p-2)}{3!}\Delta^3 y_0 + \ldots\ldots\ldots + \frac{p(p-1)(p-2)\ldots\ldots(p-n+1)}{(n)!}\Delta^n y_0$$

Where $x = x_0 + ph$**,** h=difference between two successive values of x.

$$\boldsymbol{p = \frac{x - x0}{h} = 1.8000000000}$$

The values of $\Delta y_o, \Delta^2 y_0, \Delta^3 y_0 \ldots. \Delta^n y_0$ Can be found from the following forward difference Table (Table-1).

1	1	27	9	-66	171	-326	540	-839
2	28	36	-57	105	-155	214	-299	0
3	64	-21	48	-50	59	-85	0	0
4	43	27	-2	9	-26	0	0	0
5	70	25	7	-17	0	0	0	0
6	95	32	-10	0	0	0	0	0
7	127	22	0	0	0	0	0	0
8	149	0	0	0	0	0	0	0

$\Delta y_0 = y_1 - y_0; \Delta y_1 = y_2 - y_1; \Delta y_2 = y_2 - y_3; \Delta^2 y_0 = \Delta y_1 - \Delta y_0; \Delta^3 y_0 = \Delta^2 y_1 - \Delta^2 y_0$ **And so on……**

The hand calculation is:

$$y = 1 + 1.800000 * 27 + \frac{1.800 * (1.800-1) * 9}{2!} + \frac{1.800 * (1.800-1)(1.800-2) * (-66)}{3!} + \frac{1.800 * (1.800-1)(1.800-2)(1.800-3) * (171)}{4!} + \frac{1.800 * (1.800-1)(1.800-2)(1.800-3)(1.800-4) * (-326)}{5!} + \frac{1.800 * (1.800-1)(1.800-2)(1.800-3)(1.800-4)(1.800-5) * (540)}{6!} + \frac{1.800 * (1.800-1)(1.800-2)(1.800-3)(1.800-4)(1.800-5)(1.800-6) * (-839)}{7!}$$

= 67.301793279999998

(Answer.)

Now for X=7.7;

It's done with **newton backward** method**.**

So the equation for newton backward method is:

$$y_n(x) = y_o + p\nabla y_n + \frac{p(p+1)}{2!}\nabla^2 y_n + \frac{p(p+1)(p+2)}{3!}\nabla^3 y_n + \ldots\ldots\ldots + \frac{p(p+1)(p+2)\ldots\ldots(p+n-1)}{(n)!}\nabla^n y_n$$

Where, $x = x_n + ph$, h=difference between two successive values of x.

$$\boldsymbol{p = \frac{x - x0}{h} = -0.300000}$$

Values of $\nabla y_n, \nabla^2 y_n, \nabla^3 y_n \ldots. \nabla^n y_n$ Can be found from the following backward difference Table (Table-2).

1	1	0	0	0	0	0	0	0
2	28	27	0	0	0	0	0	0
3	64	36	9	0	0	0	0	0
4	43	-21	-57	-66	0	0	0	0
5	70	27	48	105	171	0	0	0
6	95	25	-2	-50	-155	-326	0	0
7	127	32	7	9	59	214	540	0
8	149	22	-10	-17	-26	-85	-299	-839

$\nabla y_1 = y_1 - y_0$; $\nabla y_2 = y_2 - y_1$; $\nabla^2 y_2 = \nabla y_2 - \nabla y_1$; $\nabla^3 y_3 = \nabla^2 y_3 - \nabla^2 y_2$ and so on……

The hand calculation is:

$$
\begin{aligned}
y &= 1 + \text{-0.300000} * 22 + \frac{\text{-0.300} * (\text{-0.300} + 1) * -10}{2!} \\
&+ \frac{\text{-0.300} * (\text{-0.300} + 1)(\text{-0.300} + 2) * (-17)}{3!} \\
&+ \frac{\text{-0.300} * (\text{-0.300} + 1)(\text{-0.300} + 2)(\text{-0.300} + 3) * (-26)}{4!} \\
&+ \frac{\text{-0.300} * (\text{-0.300} + 1)(\text{-0.300} + 2)(\text{-0.300} + 3)(\text{-0.300} + 4) * (-85)}{5!} \\
&+ \frac{\text{-0.300} * (\text{-0.300} + 1)(\text{-0.300} + 2)(\text{-0.300} + 3)(\text{-0.300} + 4)(\text{-0.300} + 5) * (-299)}{6!} \\
&+ \frac{\text{-0.300} * (\text{-0.300} + 1)(\text{-0.300} + 2)(\text{-0.300} + 3)(\text{-0.300} + 4)(\text{-0.300} + 5)(\text{-0.300} + 6) * (-839)}{7!}
\end{aligned}
$$

=1.708980768137500e+02

(Answer.)