**ECSE 443 - Assignment 1**

**Question 1 – a)** MATLAB values, Refer to Matlab file Q1 section a

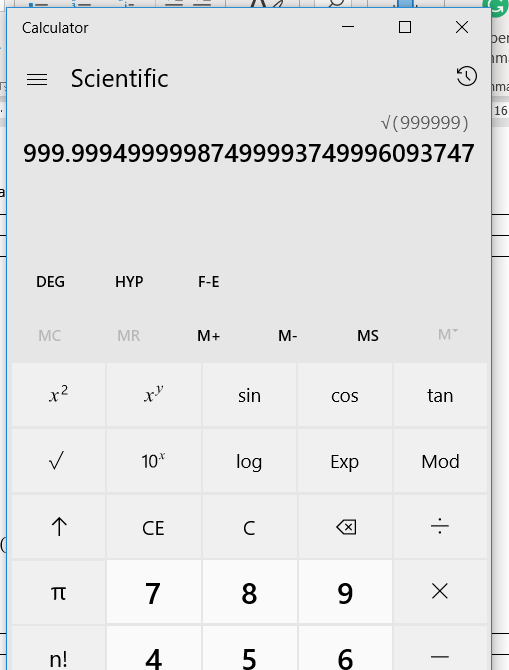
|  |  |  |  |
| --- | --- | --- | --- |
| x = | 10 | 1000 | 1000000 |
| F(x) | 1.6228 | 15.8153 | 500.0001 |

**b)** Calculator values: For these calculations I used my computer calculator which kept the most significant digits when compared to a standard calculator. This is due to the fact I wanted to keep as many digits as possible before rounding down.

For x = 10:

For x = 1000:

For x = 1000000:



|  |  |  |  |
| --- | --- | --- | --- |
| x = | 10 | 1000 | 1000000 |
| F(x) | 1.6228 | 15.8000 | 1000 |

**c)** Matlab Error Results with Calculator results. Refer to Matlab file Q1, section c.

abs\_error = 1×3

1. -0.0153 499.9999

per\_relative\_err = 1×3

0.0014 -0.0970 99.9999

The error associated with the results calculated with the calculator is from the limited number of significant figures that we can use in order to do the calculations. Therefore, we lose precision throughout the operations.

**d)** Refer to Matlab file Q1, section d for calculation.

Starting Function:

Simplified:

For X = 10:

For X = 1000:

For X = 1000000:

|  |  |  |  |
| --- | --- | --- | --- |
| x = | 10 | 1000 | 1000000 |
| F(x) | 1.62278 | 15.8153 | 500.000 |

**e)** Matlab Error Results compared with modified function results in d). Refer to Matlab file Q1, section e.

abs\_error = 1×3

10-3 ×

0.0034 -0.0431 -0.1250

per\_relative\_err = 1×3

10-3 ×

0.2094 -0.2727 -0.0250

The calculated error between the Matlab calculation and the modified function is lower for most inputs due to the elimination of subtraction in the function. When the subtraction operation occurs, it leads to a lost of significant figures when the two operands are close to one another. Therefore, the removal of this operation allows for a more precise result.

**Question 2 – a)** MATLAB values, Refer to Matlab file Q2 section a

|  |  |
| --- | --- |
| X= | 0.007 |
| F(x) | C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard5720896608659911961\image15487740869940.png |

**b)** Again, I used my computers calculator to perform the calculations due to its extra significant figures therefore when I perform my rounding later it less likely to be affected by initial rounding made by my standard calculator.

|  |  |
| --- | --- |
| X= | 0.007 |
| F(x) | 0.00342860 |

**c)** Refer to Matlab file Q2, section c.

abs\_error =

C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard5720896608659911961\image15487741274990.png

per\_relative\_err =

C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard5720896608659911961\image15487741348400.png

The error associated with the results is from the limiting number of significant figure which limits the precision of the result compared to when we use all the significant figures.

**d)** Refer to Matlab file Q2, section d for calculation.

Original Function:

Simplified Function:

For X = 0.007:

|  |  |
| --- | --- |
| X= | 0.007 |
| F(x) | 0.00350001 |

**e)** Matlab Error Results compared with modified function results in d). Refer to Matlab file Q2, section e.

abs\_error =

C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard5720896608659911961\image15487763695540.png

per\_relative\_err =

C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard5720896608659911961\image15487763814660.png

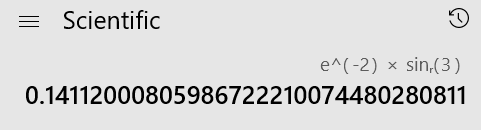
Similarly, to above in Q1, section e, the absolute and percent relative error are both much smaller due to the removal of the subtraction operation. The subtraction operation results in a loss of significant figures when the operations are similar.

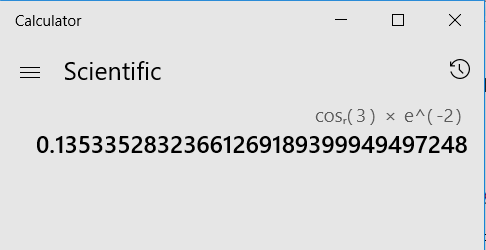
**Question 3 – a)**

Initial Function:

Derivative Function:

Solve for X = 0.5





0.11459109756681117859545744515281

Final Answer:

**b)** Refer to Matlab Q3, section b.

Output from Matlab: output = C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard5720896608659911961\image15488133420010.png

**c)**

Taylor Series of :

Taylor Series of :

Multiply the first 3 terms:

Take the derivative:

The work is also done in Matlab to compare answers in Q3, section c. Final result is:

out\_c = C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard8981640865152899635\image15489003857510.png

**d)** Refer to Matlab Q3, section d. The final output for the minimum step size is:

h = 1.000000000000000e-10

**Question 4 – a)** Refer to Matlab Q4, section a for the script and work done. The final answer is illustrated bellow.

|  |  |
| --- | --- |
| X1 | -4.770833333333334 |
| X2 | -4.450757575757576 |
| X3 | 3.757575757575756 |
| X4 | 5.575757575757576 |

x\_a = 4×1

-4.770833333333334

-4.450757575757576

3.757575757575756

5.575757575757576

**b)** Refer to Matlab Q4, section b and the function **gaussElim** for the implementation of the function.

|  |  |
| --- | --- |
| X1 | -4.770833333333338 |
| X2 | -4.450757575757579 |
| X3 | 3.757575757575760 |
| X4 | 5.575757575757579 |

x\_b = 4×1

-4.770833333333338

-4.450757575757579

3.757575757575760

5.575757575757579

**c)** Refer to Matlab Q4, section c. The absolute error for each entry was calculated as the following.

abs\_error = 4×1

10-14 ×

0.444089209850063

0.266453525910038

0.444089209850063

0.266453525910038

The maximum absolute error is:

max\_abs =

4.440892098500626e-15

**Question 5 – a)** Refer to Matlab Q5, section a to the steps in order to calculate the following Taylor Series.

f\_t(x) =   C:\Users\bjay2\AppData\Local\Temp\ConnectorClipboard5720896608659911961\image15487938496270.png

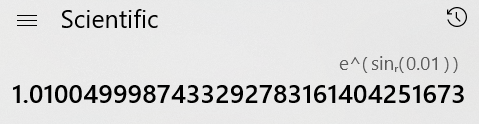
**b)** Refer to Matlab Q5, section b.

f\_b =   1.0100499999999998923527755323448218405246734619140625000000000000

**c)**

Starting Function:

Solve x = 0.01:



**d)** The results are relatively similar however, the result for c using the regular function will be more precise due to the fact that it is doing less approximation. In the case of the Taylor Series, we are approximating the value using the first 3 terms which leaves x4 error in the answer.