

# ASSIGNMENT:-06

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:

**Numerically evaluate the following integrals with**

- i) Trapezoid Method**
- ii) Simpson's 1/3 Rule**
- iii) Simpson's 3/8 Rule**

**a)  $I = \int_0^9 \frac{xdx}{x^2+4}$**

**b)  $y = f(x)$  such that some coordinate pairs are given by-(x, y) = (1, -15.997), (1.5, -17.966), (2, -19.808), (2.5, -21.267), (3, -21.813), (3.5, -20.458), (4, -15.712), (4.5, -5.089), (5, 14.875), (5.5, 49.042), (6, 103.968), (6.5, 188.257), (7, 312.947)**

**Compare the results with analytical integrals. For the first integral, comment on the accuracy of the result with variation of h (distance between two x coordinates). For both integrals, compare the accuracy of the 3 methods you used.**

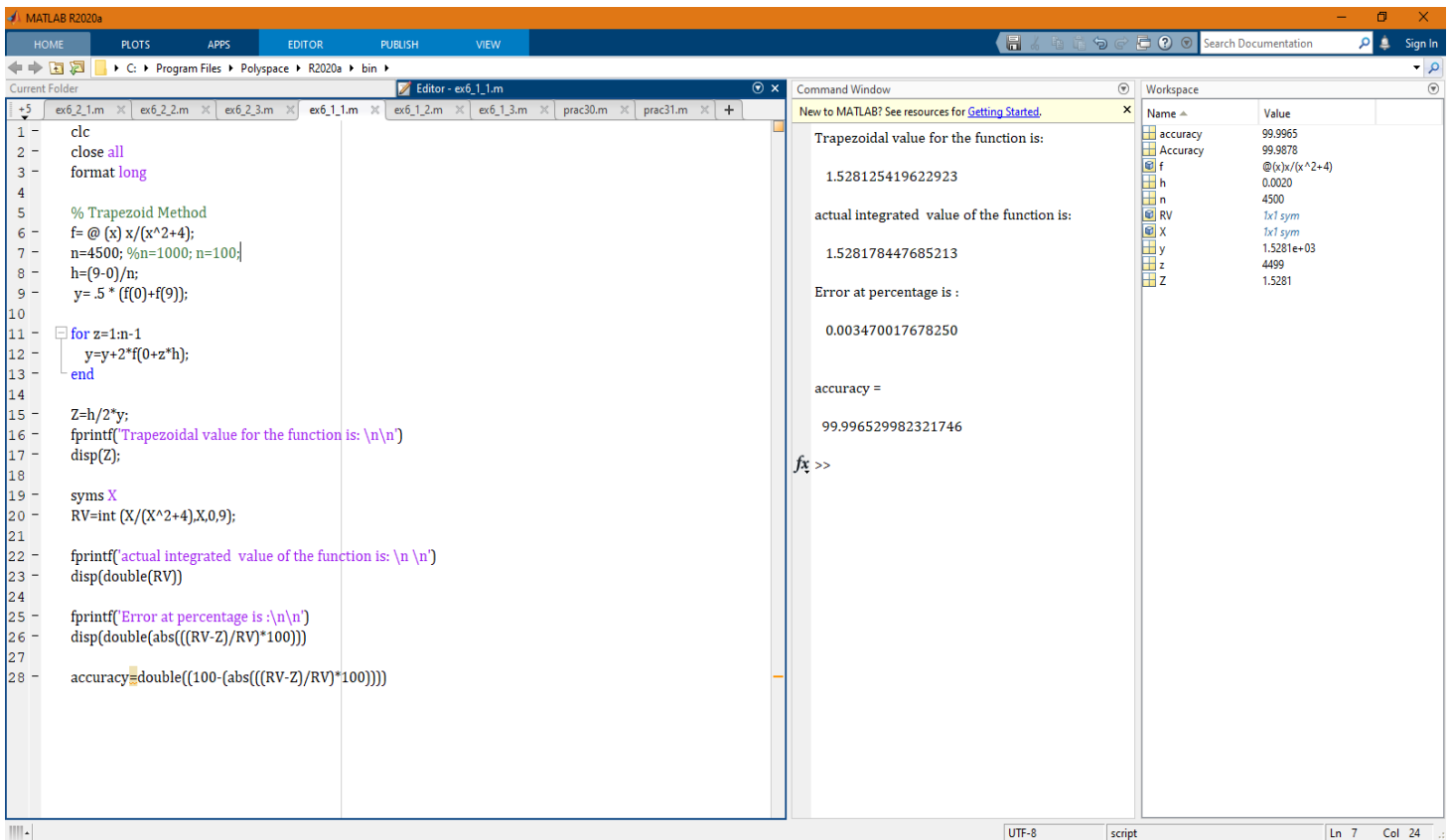
*Solution:*

Here have to find out the integrated value for 2 types of math by three methods, and also have to compare the accuracy of the three methods used. The program is given bellow.

**a)  $I = \int_0^9 \frac{xdx}{x^2+4}$**

Is solved in three methods,

# Trapezoid Method:



```
1 clc
2 close all
3 format long
4
5 % Trapezoid Method
6 f = @(x) x/(x^2+4);
7 n=4500; %n=1000; n=100;
8 h=(9-0)/n;
9 y = .5 * (f(0)+f(9));
10
11 for z=1:n-1
12     y=y+2*f(0+z*h);
13 end
14
15 Z=h/2*y;
16 fprintf('Trapezoidal value for the function is: \n\n')
17 disp(Z);
18
19 syms X
20 RV=int (X/(X^2+4),X,0,9);
21
22 fprintf('actual integrated value of the function is: \n\n')
23 disp(double(RV))
24
25 fprintf('Error at percentage is \n\n')
26 disp(double(abs(((RV-Z)/RV)*100)))
27
28 accuracy=double((100-(abs(((RV-Z)/RV)*100))))
```

Command Window

```
New to MATLAB? See resources for Getting Started.
Trapezoidal value for the function is:
1.528125419622923
actual integrated value of the function is:
1.528178447685213
Error at percentage is :
0.003470017678250
accuracy =
99.996529982321746
fx >>
```

Workspace

Name	Value
accuracy	99.9965
Accuracy	99.9878
f	@(x)x/(x^2+4)
h	0.0020
n	4500
RV	1x1 sym
X	1x1 sym
y	1.5281e+03
z	4499
Z	1.5281

Here,

Trapezoidal value for the function is:

**1.528125419622923**

Actual integrated value of the function is:

**1.528178447685213**

Error at percentage is:

**0.003470017678250%**

Accuracy =

**99.996529982321746%**

**And** the more the value of **h** increase. The more the error is increase. So I put **n=4500**. Which make the value of h more **miniature**.

# Simpson's 1/3 Rule:

```

1 clc
2 close all
3 format long
4
5 %Simpson's 1/3 Rule
6 f = @(x) x/(x^2+4);
7 n=4500;
8 h=(9-0)/n;
9 y=(f(0)+f(9));
10
11 for z=1:2:n-1
12     y=y+4*f(0+z*h);
13 end
14
15 for z=2:2:n-2
16     y=y+2*f(0+z*h);
17 end
18
19 Z=h/3*y;
20 fprintf('Simpson's 1/3 value for the function is: \n\n')
21 disp(Z)
22
23 syms X
24 RV=int (X/(X^2+4),X,0,9);
25
26 fprintf('Actual integrated value of the function is: \n\n')
27 disp(double(RV))
28
29 fprintf('Error at percentage is: \n\n')
30 disp(double(abs(((RV-Z)/RV)*100)))
31
32 Accuracy=double((100-(abs(((RV-Z)/RV)*100))))
33

```

Command Window

```

New to MATLAB? See resources for Getting Started.

Simpson's 1/3 value for the function is:

1.528178447685246

Actual integrated value of the function is:

1.528178447685213

Error at percentage is :

2.195295250849539e-12

Accuracy =

99.99999999997812
fx >>

```

Workspace

Name	Value
accuracy	100.0000
Accuracy	100.0000
ans	3.2731
c	11
C	185.0077
error	3.2731
f	@(x)x/(x^2+4)
fit	1x1 struct
fit1	1x1 struct
h	0.0020
n	4500
normresid	6.4171e-14
normresid1	6.4171e-14
pp	1x1 struct
resids	[1.4211e-14;1.0658e-1...
resids1	[1.4211e-14;1.0658e-1...
RV	1x1 sym
x	1x13 double
X	1x1 sym
y	2.2923e+03
Y	765.0080
z	4498
Z	1.5282

Here,

Simpson's 1/3 value for the function is:

**1.528178447685246**

Actual integrated value of the function is:

**1.528178447685213**

Error at percentage is:

**2.195295250849539e-12%**

Accuracy =

**99.99999999997812%**

**And** the more the value of **h** increase. The more the error is increase. So I put **n=4500**. Which make the value of h more **miniature**.

# Simpson's 3/8 Rule:

The image shows the MATLAB R2020a interface. The Editor window displays a script for implementing Simpson's 3/8 Rule. The Command Window shows the output of the script, and the Workspace window shows the variables defined in the script.

```
1 clc
2 close all
3 format long
4
5 % Simpson's 3/8 Rule
6 f = @(x) x/(x^2+4);
7 n=4500;
8 h=(9-0)/n;
9 y=(f(0)+f(9));
10
11 for z=2:3:n-1
12     y=y+3*f(0+z*h);
13 end
14 for z=3:3:n-1
15     y=y+3*f(0+z*h);
16 end
17 for z=4:3:n-3
18     y=y+2*f(0+z*h);
19 end
20
21 Z=3/8*h*y;
22 fprintf('Simpson's 3/8 value for the function is: \n\n')
23 disp(Z)
24
25 syms X
26 RV=int (X/(X^2+4),X,0,9);
27
28 fprintf('Actual integrated value of the function is: \n\n')
29 disp(double(RV))
30
31 fprintf('Error at percentage is: \n\n')
32 disp(double(abs(((RV-Z)/RV)*100)))
33
34 Accuracy=double((100-(abs(((RV-Z)/RV)*100))))
```

Command Window Output:

```
New to MATLAB? See resources for Getting Started.
Simpson's 3/8 value for the function is:
1.527992209270298
Actual integrated value of the function is:
1.528178447685213
Error at percentage is:
0.012186954684348
Accuracy =
99.987813045315647
fx >>
```

Workspace:

Name	Value
accuracy	99.9965
Accuracy	99.9878
f	@(x)x/(x^2+4)
h	0.0020
n	4500
RV	1x1 sym
X	1x1 sym
y	2.0373e+03
z	4495
Z	1.5280

Here,

Simpson's 3/8 value for the function is:

**1.527992209270298**

Actual integrated value of the function is:

**1.528178447685213**

Error at percentage is:

**0.012186954684348%**

Accuracy:

**99.987813045315647%**

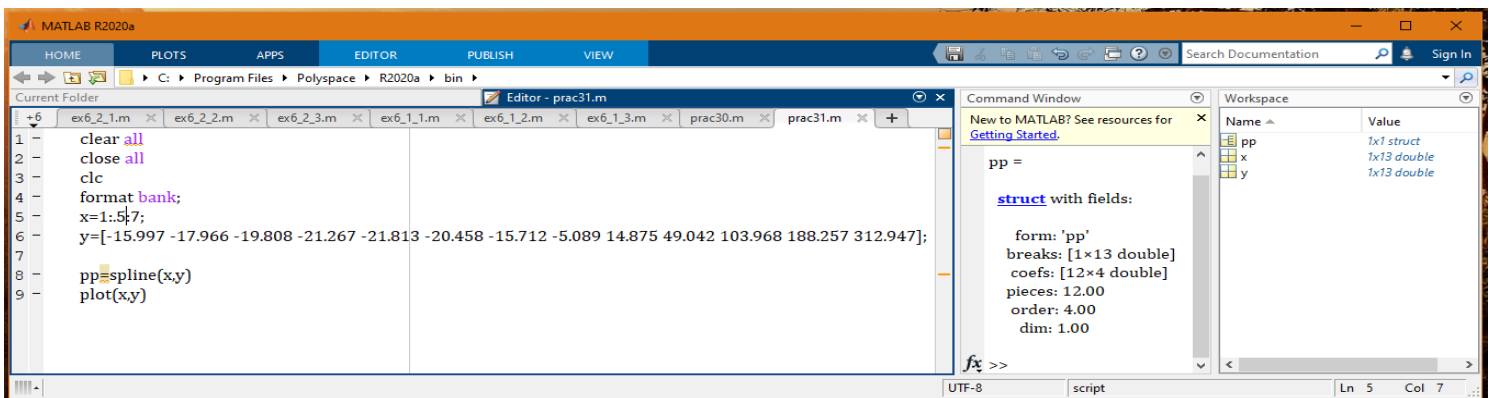
**And** the more the value of **h** increase. The more the error is increase. So I put **n=4500**. Which make the value of h more **miniature**.

## Comment:

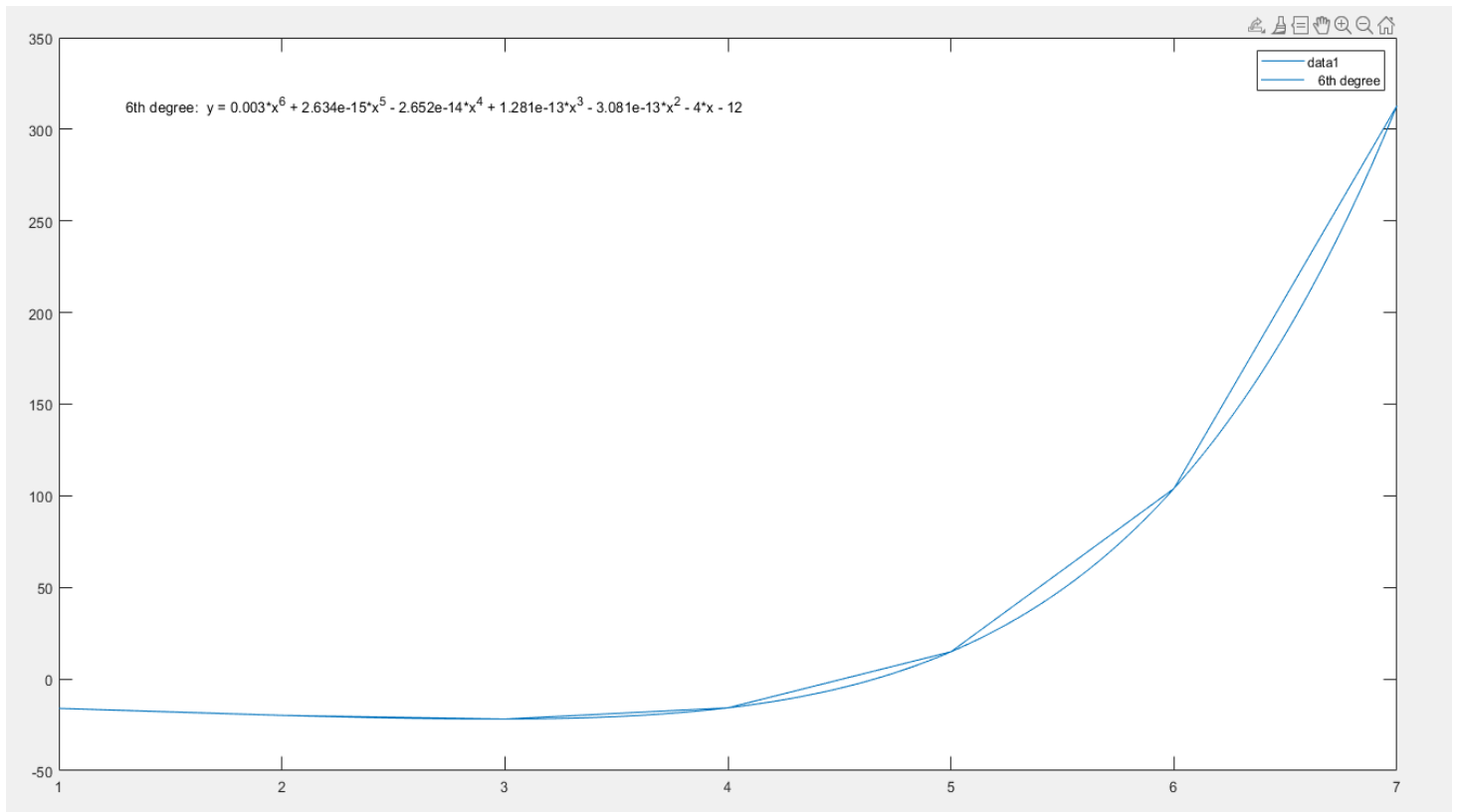
**\*\*All are much accurate. Because the value of h is too small. If I increase the value of h its accuracy will decrease. To compare these method I can say that “Simpson’s 1/3 Rule” has most accuracy among them\*\*.**

**(b)  $y = f(x)$  Such that some coordinate pairs are given by-(x, y) = (1,-15.997), (1.5, -17.966), (2,-19.808), (2.5, -21.267), (3, -21.813), (3.5, -20.458), (4,-15.712), (4.5, -5.089), (5, 14.875), (5.5, 49.042), (6,103.968), (6.5, 188.257), (7, 312.947)**

Here to calculate the accuracy, **we need an equation. So I plot the values and will get an equation** from the basic fitting of the graph.



**The graph according the value is:**



**The equation is:**

$$y = 0.003x^6 + 2.6338e-15x^5 - 2.6521e-14x^4 + 1.2812e-13x^3 - 3.0805e-13x^2 - 4x - 12$$

Now again the equation is solves by three methods. These are:

- i) Trapezoid Method
- ii) Simpson's 1/3 Rule
- iii) Simpson's 3/8 Rule

**The programs are given bellow:**

# Trapezoid Method:

Current Folder: C:\Program Files\Polyspace\R2020a\bin

Editor - ex6\_2\_1.m

```

1 clc
2 close all
3 format short
4 x=[1:5:7];
5 y=[-15.997 -17.966 -19.808 -21.267 -21.813 -20.458 -15.712 -5.089 14.875 49.042 103.968 188.257 312.947];
6 n=length(y);
7 h=(x(2)-x(1));
8 Y=(y(1)+y(n));
9
10 for z=2:n-1
11     Y=Y+2*(y(z));
12 end
13
14 Z=h*.5*(Y);
15 fprintf('Trapezoidal value for the function is: \n\n')
16 disp(Z);
17
18 syms X
19 RV=int(0.003*X^6 + 2.6338e-15*X^5 -2.6521e-14*X^4 + 1.2812e-13*X^3 -3.0805e-13*X^2 -4*X -12,X,1,7);
20
21 fprintf('Actual integrated value of the function is: \n\n')
22 disp(double(RV))
23
24 fprintf('Error at percentage is: \n\n')
25 disp(double(abs(((RV-Z)/RV)*100)))
26
27 Accuracy=double(100-(abs(((RV-Z)/RV)*100)))
28

```

Command Window

New to MATLAB? See resources for [Getting Started](#).

Trapezoidal value for the function is:

191.2520

Actual integrated value of the function is:

184.9466

Error at percentage is :

3.4093

Accuracy =

96.5907

fx >>

Workspace

Name	Value
accuracy	96.5907
Accuracy	96.5907
h	0.5000
n	13
pp	1x1 struct
RV	1x1 sym
x	1x13 double
X	1x1 sym
y	1x13 double
Y	765.0080
z	12
Z	191.2520

UTF-8 script Ln 21 Col 11

Here,

Trapezoidal value for the function is:

**191.2520**

Actual integrated value of the function is:

**184.9466**

Error at percentage is:

**3.4093%**

Accuracy =

**96.5907%**



# Simpson's 1/3 Rule:

```
1 clc
2 close all
3 format short
4 x=[1:5:7];
5 y=[-15.997 -17.966 -19.808 -21.267 -21.813 -20.458 -15.712 -5.089 14.875 49.042 103.968 188.257 312.947];
6 n=length(y);
7 h=(x(2)-x(1));
8 Y=y(1)+y(n);
9
10 for z=2:2:n-1
11     Y=Y+4*y(z);
12 end
13
14 for z=3:2:n-2
15     Y=Y+2*y(z);
16 end
17
18 Z=1/3*(h*Y);
19 fprintf('Simpson's 1/3 value for the function is: \n\n')
20 disp(Z);
21
22 syms X
23 RV=int(0.003*X^6 + 2.6338e-15*X^5 - 2.6521e-14*X^4 + 1.2812e-13*X^3 - 3.0805e-13*X^2 - 4*X - 12,X,1,7);
24
25 fprintf('actual integrated value of the function is: \n\n')
26 disp(double(RV))
27
28 fprintf('Error at percentage is: \n\n')
29 disp(double(abs(((RV-Z)/RV)*100)))
30
31 accuracy=double((100-(abs(((RV-Z)/RV)*100))))
```

Command Window

```
New to MATLAB? See resources for Getting Started.

Simpson's 1/3 value for the function is:

185.0077

actual integrated value of the function is:

184.9466

Error at percentage is :

0.0330

accuracy =

99.9670

fx >>
```

Workspace

Name	Value
accuracy	99.9670
Accuracy	96.5907
h	0.5000
n	13
pp	1x1 struct
RV	1x1 sym
x	1x13 double
X	1x1 sym
y	1x13 double
Y	1.1100e+03
z	11
Z	185.0077

Here,

Function Simpson's 1/3 value for the is:

**185.0077**

Actual integrated value of the function is:

**184.9466**

Error at percentage is:

**0.0330%**

Accuracy:

**99.9670%**

# Simpson's 3/8 Rule:

The image shows the MATLAB R2020a interface. The Editor window displays a script for implementing Simpson's 3/8 Rule. The Command Window shows the output of the script, and the Workspace window shows the variables created during execution.

```
1 clc
2 close all
3 format short
4 x=[1:5:7];
5 y=[-15.997 -17.966 -19.808 -21.267 -21.813 -20.458 -15.712 -5.089 14.875 49.042 103.968 188.257 312.947];
6 n=length(y);
7 h=(x(2)-x(1));
8 Y=(y(1)+y(n));
9
10 for z=2:3:n-1
11     Y=Y+3*y(z);
12 end
13 for z=3:3:n-1
14     Y=Y+3*y(z);
15 end
16 for z=4:3:n-3
17     Y=Y+2*y(z);
18 end
19
20 Z=3/8*h*Y;
21 fprintf('Simpson's 3/8 value for the function is: \n\n')
22 disp(Z);
23
24 syms X
25 RV=int(0.003*X^6 + 2.6338e-15*X^5 -2.6521e-14*X^4 + 1.2812e-13*X^3 -3.0805e-13*X^2 -4*X -12,X,1,7);
26
27 fprintf('Actual integrated value of the function is: \n\n')
28 disp(double(RV))
29
30 fprintf('Error at percentage is : \n\n')
31 disp(double(abs(((RV-Z)/RV)*100)))
32
33 Accuracy=double((100-(abs(((RV-Z)/RV)*100))))
```

Command Window Output:

```
New to MATLAB? See resources for Getting Started.
Simpson's 3/8 value for the function is:
185.0576
Actual integrated value of the function is:
184.9466
Error at percentage is :
0.0600
Accuracy =
99.9400
```

Workspace Variables:

Name	Value
accuracy	99.9670
Accuracy	99.9400
h	0.5000
n	13
pp	1x1 struct
RV	1x1 sym
x	1x13 double
X	1x1 sym
y	1x13 double
Y	986.9740
z	10
Z	185.0576

Here,

Simpson's 3/8 value for the function is:

**185.0576**

Actual integrated value of the function is:

**184.9466**

Error at percentage is:

**0.0600%**

Accuracy:

**99.9400%**

**Comment:**

**\*\* To compare these method I can say that again "Simpson's 1/3 Rule" has most accuracy among them. \*\***