EM314 – NUMERICAL METHODS

Assignment - Integration

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E/15/154

(1). a) Write a function to compute an integral estimate for any given function using the Composite Trapezoidal rule for a given number of segments.

```
function CompositeTrapezoidal(f,seg,a,b)

realVal=integral(f,a,b);
h=(b-a)/seg;

x0=a;
xn=b;

begin=f(x0);
last=f(xn);

x=x0+h;
temp=0;

while x < xn
    temp=temp+2*f(x);
    x=x+h;
end

I=(h/2)*(begin+temp+last);
rError=((realVal-I)/realVal)*100;

fprintf('From Composite Trapezoidal Rule = %f\n',I);
fprintf('Analytical Value = %f\n',realVal);
fprintf('Relative Error = %f\n',rError);
```

b) (i)

```
f=@(x) 1-x-4*x.^3+2*x.^5;
a=0;
b=4;
seg=2;
CompositeTrapezoidal(f,seg,a,b)
```

>>**output**

From Composite Trapezoidal Rule = 1852.000000

Analytical Value = 1105.333333

Relative Error = -67.551267

(ii)

```
f=@(x) 1-x-4*x.^3+2*x.^5;
a=0;
b=4;
seg=3;
CompositeTrapezoidal(f,seg,a,b)
```

>>**output**

From Composite Trapezoidal Rule = 1447.720165

Analytical Value = 1105.333333

Relative Error = -30.975889

(iii)

```
f=@(x) 1-x-4*x.^3+2*x.^5;
a=0;
b=4;
seg=4;
CompositeTrapezoidal(f,seg,a,b)
```

>>**output**

From Composite Trapezoidal Rule = 1300.000000

Analytical Value = 1105.333333

Relative Error = -17.611580

(c). Write a function to compare an integral estimate for any given function using the Multiple application of Simpson's 1/3 rule for given number of segments.

```
function Simpsons_one3_rule(f,seg,a,b)

realVal=integral(f,a,b);
h=(b-a)/seg;

x0=a;
xn=b;

begin=f(x0);
last=f(xn);

x_odd=x0+h;
x_even=x0+2*h;
temp1=0;
temp2=0;

while x_odd < xn
    temp1=temp1+4*f(x_odd);
    x_odd=x_odd+2*h;
end

while x_even < xn
    temp2=temp2+2*f(x_even);
    x_even=x_even+2*h;
end

I=(h/3)*(begin+temp1+temp2+last);
rError=((realVal-I)/realVal)*100;

fprintf('From Simpsons 1/3 Rule = %f\n',I);
fprintf('Analytical Value = %f\n',realVal);
fprintf('Relative Error = %f\n',rError);
```

d) (i)

```
f=@(x) 1-x-4*x.^3+2*x.^5;
a=0;
b=4;
seg=2;
Simpsons_one3_rule(f,seg,a,b)
```

>>**output**

From Simpsons 1/3 Rule = 1276.000000

Analytical Value = 1105.333333

Relative Error = -15.440290

(ii)

```
f=@(x) 1-x-4*x.^3+2*x.^5;
a=0;
b=4;
seg=3;
Simpsons_one3_rule(f,seg,a,b)
```

>>**output**

From Simpsons 1/3 Rule = 963.914037

Analytical Value = 1105.333333

Relative Error = 12.794267

(iii)

```
f=@(x) 1-x-4*x.^3+2*x.^5;
a=0;
b=4;
seg=4;
Simpsons_one3_rule(f,seg,a,b)
```

>>**output**

From Simpsons 1/3 Rule = 1116.000000

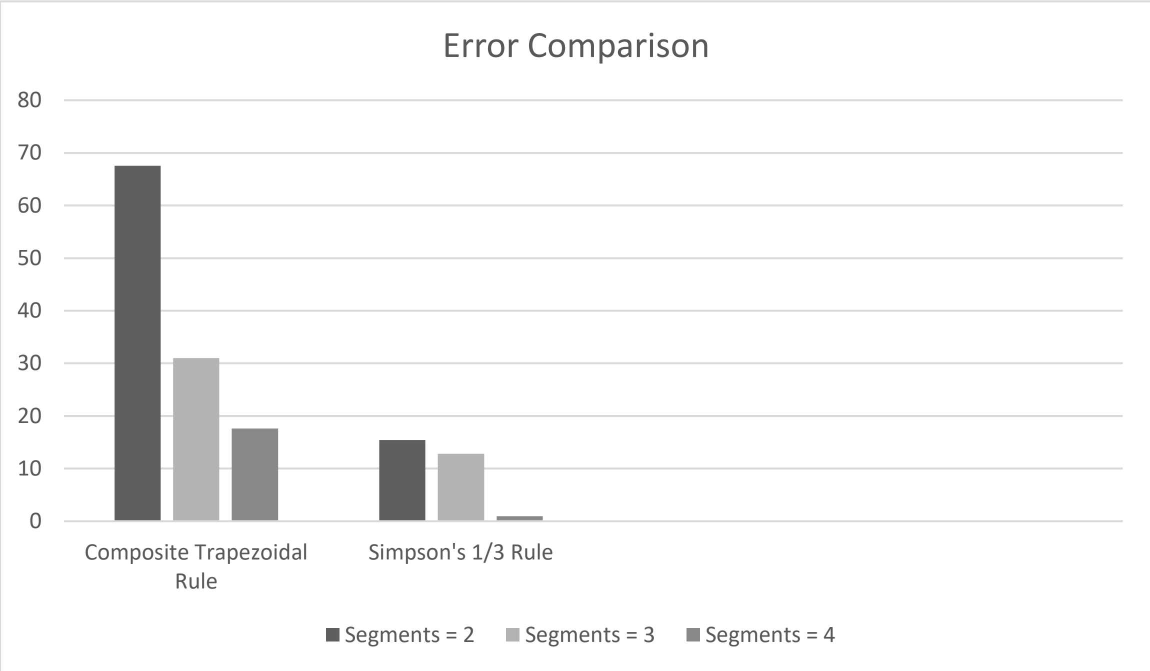
Analytical Value = 1105.333333

Relative Error = -0.965018

e) Discuss the variation in convergence rate with the step size for the integral given in part (b) using

(i) Composite Trapezoidal rule

(ii) Multiple application of Simpson's 1/3 rule



Here absolute values of the relative is compared with each other. When the number of segments is increased, error has been reduced.

When it's compared with Composite Trapezoidal Rule, Simpson's 1/3 rule is more accurate.

02.

a) Evaluate β(1,2), β(1.5,2.5) and β(2,3) for different number of segments using,

(i) Composite Trapezoidal rule

(ii) Multiple application of Simpson's 1/3 rule

>>**sample code**

```
m=1.5;
n=2.5;
f=@(x) (x.^(m-1)).*((1-x).^(n-1));
a=0;
b=1;
seg=2;

CompositeTrapezoidal(f,seg,a,b)
Simpsons_one3_rule(f,seg,a,b)
```

>>**output**

```
From Composite Trapezoidal Rule =
0.125000

Analytical Value = 0.196350

Relative Error = 36.338023

From Simpsons 1/3 Rule = 0.166667

Analytical Value = 0.196350

Relative Error = 15.117364
```

No. of Segments	β(1,2)	β(1.5,2.5)	β(2,3)
4	0.500000	0.170753	0.078125
6	0.500000	0.182347	0.081019
8	0.500000	0.187232	0.082031

<u>Evaluated values using Composite Trapezoidal Rule</u>

No. of Segments	β(1,2)	β(1.5,2.5)	β(2,3)
4	0.500000	0.186004	0.083333
6	0.500000	0.190751	0.083333
8	0.500000	0.192725	0.083333

<u>Evaluated values using Simpson's 1/3 Rule</u>

No. of Segments	β(1,2)	β(1.5,2.5)	β(2,3)
4	0.000000	13.036122	6.250000
6	0.000000	7.131392	2.777778
8	0.000000	4.643619	1.562500

<u>Relative Errors of Composite Trapezoidal Rule</u>

No. of Segments	β(1,2)	β(1.5,2.5)	β(2,3)
4	0.000000	5.268822	0.000000
6	0.000000	2.851228	0.000000
8	0.000000	1.846118	0.000000

Relative Errors of Simpson’s 1/3 Rule

As the step size reduces, relative error also reduces.

Simpson’s 1/3 Rule method gives the more accurate values than Composite Trapezoidal Rule.