

Ryan Fahrenkrug

MECH 105

Homework 19

11/8/2017

```
clc
clear
close all
```

Part 1

Romberg Integration

```
a=0;
H=30;
syms z
an=int(200*(z/(5+z))*exp((-2*z)/H),a,H);
fun=@(z) 200*(z./(5+z)).*exp((-2.*z)./H);
et=@(true,est) double(abs((true-est)/true)*100);

% h = 1
x1 = a:1:H;
y1 = fun(x1);
I1 = trapz(x1,y1);
es1 = et(an,I1);
fprintf('The first approximation with h=1 is %6.2f\n',I1);
```

The first approximation with h=1 is 1477.13

```
fprintf('The error is %3.4f\n',es1);
```

The error is 0.2320

```
% h = 1/2
x2 = a:1/2:H;
y2 = fun(x2);
I2 = trapz(x2,y2);
es2 = et(an,I2);
fprintf('The second approximation with h=1/2 is %6.2f\n',I2);
```

The second approximation with h=1/2 is 1479.71

```
fprintf('The error is %3.4f\n',es2);
```

The error is 0.0582

```
% Romberg iteration
I3= (4/3)*I2 - (1/3)*I1;
es3 = et(an,I3);
fprintf('The estimated integral using Romberg integration is %6.2f\n',I3);
```

The estimated integral using Romberg integration is 1480.56

```
fprintf('The error is %3.4f\n',es3);
```

The error is 0.0003

Part 2

Two-point Gauss-Legendre

```
dx=(H-a)/2;
G=@(xd) (200.*((((H+a)+(H-a).*xd)./2)./(5+((((H+a)+(H-a).*xd)./2))).*exp((-2.*((((H+a)+(H-a).*xd)./2))/H)).*dx;
IG=G(-1/sqrt(3))+G(1/sqrt(3));
```

```
ea=et(an,IG);  
fprintf('The estimated integral using two-point Gauss-Legendre is %6.2f\n',IG);
```

The estimated integral using two-point Gauss-Legendre is 1610.57

```
fprintf('The true error is %3.2f\n',ea);
```

The true error is 8.78

Part 3

MATLAB Integral Function

```
a=0;  
H=30;  
syms z  
an=int(200*(z/(5+z))*exp((-2*z)/H),a,H);  
fprintf('The analytical solution is %6.2f\n',an);
```

The analytical solution is 1480.57