DATE : / /
PAGE NO. :

Assignment 6

Q. Calculate the value of integral $I = \int_0^{30} \left(\frac{250x}{x+6}\right) e^{-x/10} dx$ using guss quadrature & trapezoidal method.

Sol. Trapezoidal Rule: $h \rightarrow$ size of interval

$$I = \frac{h}{2}\left[f(a) + 2f(a+h) + 2f(a+2h) \text{ ..... } 2f(a+(n-1)h) + f(b)\right]$$

where n = no. of intervals $= \frac{b-a}{h}$

Gauss Quadrature

For interval a_1, b_1

$$I = c_0 g\left(\frac{-1}{\sqrt{3}}\right) + c_1 g\left(\frac{1}{\sqrt{3}}\right) \text{ where } c_0 = c_1 = 1$$

$$\int_{a_1}^{b_1} f(x)dx = \int_{-1}^{1} g(t)dt$$

$$g(t) = \frac{(b_1 - a_1)}{2} f\left(\left(\frac{b_1 - a_1}{2}\right)t + \frac{a_1 + b_1}{2}\right)$$

DATE : / /
PAGE NO. :

So we divide (a, b) into n intervals of size $h \Rightarrow \frac{b-a}{h} = n$

For each interval we calculate

$$I = C_0 g\left(\frac{-1}{\sqrt{3}}\right) + C_1 g\left(\frac{1}{\sqrt{3}}\right)$$

for i th interval

where $g_i = \frac{h}{2} f\left(\frac{h}{2} t + a + ih - \frac{h}{2}\right)$

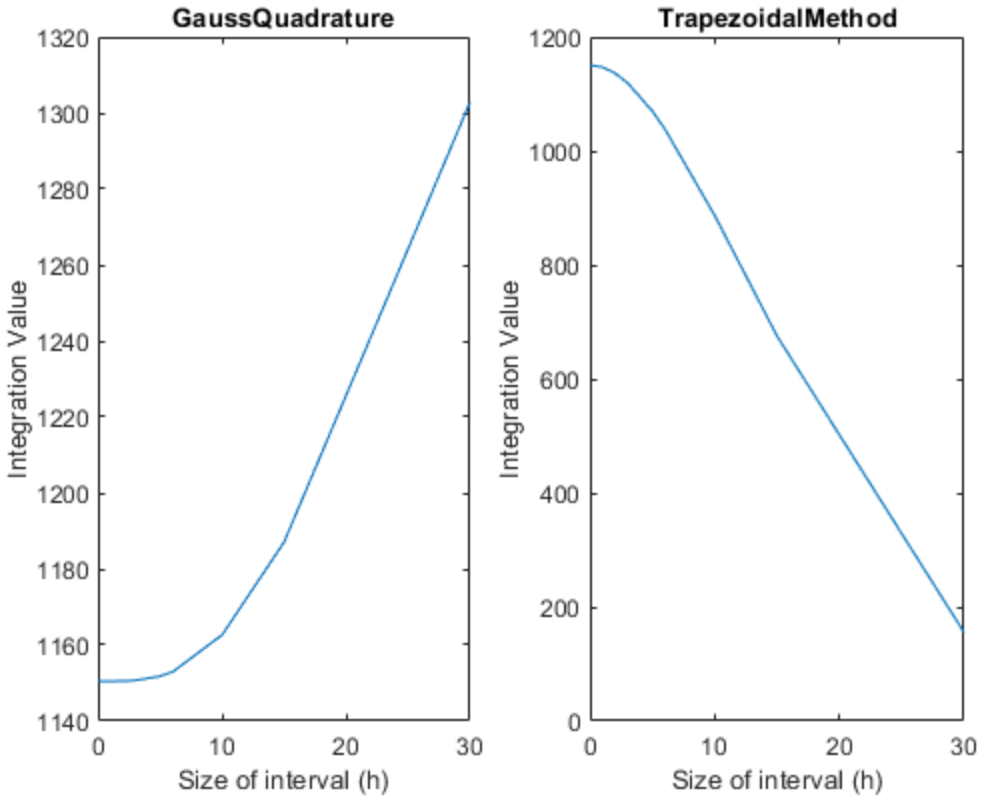
then we do summation of integrals obtained in all the intervals.

$$I_{total} = I_1 + I_2 + I_3 \cdots I_n$$

value of integral = 1150.4697

```
h = [30 15 10 6 5 3 2 1 0.1 0.01 0.001 0.0001 0.00001 0.000001];
trp = h;
gaussQuadrature = h;
a = 0;
b =30;
for i = 1:length(h)
    trp(i)= trapezoidal(h(i),a,b);
    gaussQuadrature(i)=gaussQuad(h(i),a,b);
end

%Plotting for gauss quad
subplot(1, 2, 1);
plot(h,gaussQuadrature);
title("GaussQuadrature");
xlabel("Size of interval (h)");
ylabel("Integration Value");

%plot for Trapezoidal rule
subplot(1, 2, 2);
plot(h,trp);
title("TrapezoidalMethod");
xlabel("Size of interval (h)");
ylabel("Integration Value");

%Integral values using methods
display("value of integration using gauss quadrature
 "+gaussQuadrature(14))
display("value of integration using trapezoidal method "+trp(14))
```

```
    "value of integration using gauss quadrature 1150.4697"

    "value of integration using trapezoidal method 1150.4697"
```



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```
function result = f(x)
% returns function value
result = (250*x/(x+6))*exp(-1*x/10);
return
end
```

```
Not enough input arguments.

Error in f (line 3)
result = (250*x/(x+6))*exp(-1*x/10);
```

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```
function result = trapezoidal(h,a,b)
% returns the value of integral using trapezoidal rule
n = (b-a)/h;
integral = f(a);
for i =1:n-1
    integral = integral + 2*f(a+i*h);
end
integral = integral + f(b);
result = (h/2)*integral;
end
```

```
Not enough input arguments.

Error in trapezoidal (line 3)
n = (b-a)/h;
```

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```
function result = gaussQuadofSingleInterval(a,b)
p = (b-a)/2;
q = (a+b)/2;
t = 1/sqrt(3);
% g(t) = p*f(p*t +q) & C0 = C1 = 1
result = p*f(p*(-1*t)+q) + p*f(p*(1*t)+q); % returns C0*g(t0) +
 C1*g(t1) for interval (a,b)
return
end
```

```
Not enough input arguments.

Error in gaussQuadofSingleInterval (line 2)
p = (b-a)/2;
```

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```
function result = gaussQuad(h,a,b)
n = (b-a)/h;
integral = 0;
for i = 1:n
    %Add up the values of integral in all intervalss
    integral = integral + gaussQuadofSingleInterval(a+(i-1)*h,a+i*h);
end
% return the total integral value
result =  integral;
return
end
```

```
Not enough input arguments.

Error in gaussQuad (line 2)
n = (b-a)/h;
```

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