Problem 2: For the optimization problem, 𝑀𝑖𝑛𝑚𝑖𝑧𝑒 𝑓( 𝑥) = sin(0.1 + 2𝛼)/(0.1 + 𝛼) 𝑆𝑢𝑏 𝑡𝑜 0 ≤ 𝛼 ≤ 10 Write Matlab program to bracket the minima and obtain lower and upper bounds. Optimize the objective function with quadratic and cubic polynomial approximation using three and four points.

Three-Point Quadratic Approximation:

syms x y

f(x)=sin(0.1+2\*x)/(0.1+x);

x1=0;

x2=5;

x3=10;

a2=((f(x3)-f(x1))/(x3-x1)-(f(x2)-f(x1))/(x2-x1))/(x3-x2);

a1=(f(x2)-f(x1))/(x2-x1)-a2\*(x1+x2);

a0=f(x1)-a1\*x1-a2\*x1^2;

double(a0) % 0.9983

double(a1) %-0.3579

double(a2) % 0.0267

minima x\*=-a1/2\*a2;

x\*= 6.6905

f(x)min=0.1167

Three-Point Cubic Approximation

syms x y

f(x)=sin(0.1+2\*x)/(0.1+x);

z(x)=diff(sin(0.1+2\*x)/(0.1+x));

x1=0;

x2=5;

x3=10;

a3=(f(x3)-f(x1))/((x3-x2)\*(x3-x1)^2)-(f(x2)-f(x1))/((x3-x2)\*(x2-x1)^2)+z(x1)/((x2-x1)\*(x3-x1));

a2=((f(x2)-f(x1))/(x2-x1)-z(x1))/(x2-x1)-a3\*(2\*x1+x2);

a1=z(x1)-2\*a2\*x1-3\*a3\*x1^3;

a0=f(x1)-a1\*x1-a2\*x1^2-a3\*x1^3;

double(a0) %0.9983

double(a1) %9.9167

double(a2) %-3.0557

double(a3) %0.2055

x1\*=(-2\*a2+sqrt(a2^2-3\*a1\*a3))/(3\*a3);

x2\*=(-2\*a2-sqrt(a2^2-3\*a1\*a3))/(3\*a3);

b>0,so x1\*minima x2\*maxima

x1\*=12.8256 (out)

x2\*=7.0008

f(x)min=0.0449

f(x)max=0.1447

Four-Point Cubic Approximation

syms x y

f(x)=sin(0.1+2\*x)/(0.1+x);

z(x)=diff(sin(0.1+2\*x)/(0.1+x));

x1=0;

x2=3;

x3=6;

x4=10;

q1=x3^3\*(x2-x1)-x2^3\*(x3-x1)+x1^3\*(x3-x2);

q2=x4^3\*(x2-x1)-x2^3\*(x4-x1)+x1^3\*(x4-x2);

q3=(x3-x2)\*(x2-x1)\*(x3-x1);

q4=(x4-x2)\*(x2-x1)\*(x4-x1);

q5=f(x3)\*(x2-x1)-f(x2)\*(x3-x1)+f(x1)\*(x3-x2);

q6=f(x4)\*(x2-x1)-f(x2)\*(x4-x1)+f(x1)\*(x4-x2);

a3=(q3\*q6-q4\*q5)/(q2\*q3-q1\*q4);

a2=(q5-a3\*q1)/q3;

a1=(f(x2)-f(x1))/(x2-x1)-a3\*(x2^3-x1^3)/(x2-x1)-a2\*(x1+x2);

a0=f(x1)-a1\*x1-a2\*x1^2-a3\*x1^3;

double(a0) %0.9983

double(a1) %-0.6182

double(a2) %0.1040

double(a3) %-0.0051

b>0

c1=(-2\*a2+sqrt(a2^2-3\*a1\*a3))/(3\*a3);

c2=(-2\*a2-sqrt(a2^2-3\*a1\*a3))/(3\*a3);

double(c1)

double(c2)

x1\*=11.1771(out of bound)

x2\*=15.9007(out of bound)

f(x)min=-0.0397

f(x)max=0.0292

Problem 3: For the optimization problem defined in Problem 2, write Matlab program to utilize ‘Golden Section method’ to obtain the minima of the objective function. Use the lower and upper bounds obtained in Problem 2 which brackets the minima

Use lower and upper bound in Three-Point Cubic[7,10]

syms x y e

f(x)=sin(0.1+2\*x)/(0.1+x);

xl=7;

xu=10;

fl=f(xl);

fu=f(xu);

e=0.23;

N=1;

T=0.38197;

while e>0.01

x1=xl+T\*(xu-xl);

x2=xu-T\*(xu-xl);

if f(x1)>f(x2)

xl=x1;

else x2=xu;

end

e=(1-T)^N;

N=N+1;

end

x1 %8.8541

x2 %10

f(x1) %-0.0964

f(x2) %0.0940