%列三转角方程组并求解

function [A,g,h,m] =tae(X,Y,f1,fn,n)

h=zeros(n-1,1);%用来储存两节点之间的距离

f=zeros(n-1,1);%用来储存差商值

for i=1:n-1

    h(i)=X(i+1)-X(i);%计算两节点之间的距离

    f(i)=(Y(i+1)-Y(i))/(X(i+1)-X(i));%计算两点的差商值

end

a=zeros(n-1,1);b=zeros(n-1,1);g=zeros(n,1);%用来储存矩阵的系数值

for i=2:n-1

    a(i)=h(i)/(h(i-1)+h(i));

    b(i)=h(i-1)/(h(i-1)+h(i));%计算三对角矩阵A次对角线的值

    g(i)=3\*(a(i)\*f(i-1)+b(i)\*f(i));g(1)=f1;g(n)=fn;%计算矩阵等式Am=g中g的值

end

A=zeros(n,n);

for i=1:n-2

    A(i+1,i)=b(i+1);A(1,1)=1;

    A(i+1,i+2)=a(i+1); %把上述计算的值赋给系数矩阵A

    A(i,i)=2;A(n-1,n-1)=2;A(n,n)=1;

end

m=(A)\g;%求解出M,M为各节点二阶导数值

end

%测试用主程序

clear

n=5;

f1=1;fn=0.6868;%初值条件，两端的一阶导数值

%X1=randsample(10,n);Y=randsample(100,n);

%X=sort(X1);

% X=[0,1,2,3];       %节点值

% Y=[0,0.5,2.0,1.5];%节点处的函数值

X=[0.25,0.30,0.39,0.45,0.53];       %节点值

Y=[0.5000,0.5477,0.2245,0.8708,0.7280];%节点处的函数值

[A,g,h,m] =tae(X,Y,f1,fn,n);

syms x; %定义一个符号变量，代替函数的自变量

digits(4); %设置精度

%vpa()将分数转换为小数，collect()合并同类项

S=sym(zeros(1, n-1));

for i=1:n-1

    fprintf('In [x\_%d, x\_%d]\n',i,i+1);

    S(i)=vpa(collect((x-X(i+1))^2\*(h(i)+2\*(x-X(i)))\*Y(i)/(h(i)^3)+...

        (x-X(i))^2\*(h(i)+2\*(X(i+1)-x))\*Y(i+1)/(h(i)^3)+...

        (x-X(i+1))^2\*(x-X(i))\*m(i)/(h(i)^2)+...

        (x-X(i))^2\*(x-X(i+1))\*m(i+1)/(h(i)^2)));

    fprintf('S\_%d(x)=',i);

    disp(S(i));

end

%画图

hold on

for i=1:n-1

    y=X(i):0.005:X(i+1);

    plot(y,subs(S(i),x,y));%subs()用数值y替代符号变量x求解函数值

    y=X(i);

    plot(y,subs(S(i),x,y),'\*');

end

y=X(n);

plot(y,subs(S(n-1),x,y),'\*');

hold off