A.2 code

clear

clc

pkg load symbolic

h=[1,0.5,0.1,0.05,0.01,0.005]

x=4;

f=ones(1,6).\*(x\*cos(x)-3\*sin(x))/x^4;

fderiv1=zeros(1,6);

fderiv2=zeros(1,6);

fderiv4=zeros(1,6);

%%%forward difference

for i=1:6

fderiv1(i)=((sin(x+h(i))/(x+h(i))^3)-(sin(x)/x^3))/h(i)

end

%%%second-order difference

for i=1:6

fderiv2(i)=((sin(x+h(i))/(x+h(i))^3)-(sin(x-h(i))/(x-h(i))^3))/(2\*h(i))

end

%%%fourth-order central difference

for i=1:6

fderiv4(i)=((sin(x-2\*h(i))/(x-2\*h(i))^3)-8\*(sin(x-h(i))/(x-h(i))^3)+8\*(sin(x+h(i))/(x+h(i))^3)-(sin(x+2\*h(i))/(x+2\*h(i))^3))/(12\*h(i))

end

abs(fderiv1-f)

abs(fderiv2-f)

abs(fderiv4-f)

errorf1 = log10(abs(fderiv1-f))

errorf2 = log10(abs(fderiv2-f))

errorf4 = log10(abs(fderiv4-f))

t=log10(h)

plot(t,errorf1,'-r+',t,errorf2,'-c\*',t,errorf4,'-b\*');

xlabel("log(h)");

ylabel("log(error)");

legend("1st order","2nd order","4th order");

B.2 code

clear

clc

x=linspace(0,pi)

y1=sin(x);

y2=(4\*sin(x)-1/2\*sin(2\*x))/3;

y3=(3\*sin(x))./(2+cos(x));

plot(x,x)

hold on

plot(x,y1,"o")

hold on

plot(x,y2,"+")

hold on

plot(x,y3,"\*")

hold on

xlabel("kh");

ylabel("k'h");

legend("Exact","2nd O Central","4th O Central","4th O Pade");

C.2 code

clear

clc

%%let x has 15 columns

x=0:(3/14):3;

y=sin(5\*x);

h=3/14;

a=zeros(15,15);

a(1,1)=1;

a(1,2)=2;

a(15,14)=2;

a(15,15)=1;

for i=2:14

a(i,(i-1))=1;

a(i,i)=4;

a(i,(i+1))=1;

end

c=zeros(15,1);

c(1,1)=1/h.\*(-5/2.\*y(1)+2.\*y(2)+1/2.\*y(3));

c(15,1)=1/h.\*(5/2.\*y(15)-2.\*y(14)-1/2.\*y(13));

for i=2:14

c(i,1)=3/h.\*(y(i+1)-y(i-1));

end

t=0:0.01:3

b=pinv(a)\*c

plot(t,5\*cos(5\*t),"-r");

hold on;

plot(x,b,"-bo");

legend("Exact","f'(x)");

xlabel("x");

ylabel("y");

D.4 code

clear

clc

x=linspace(0,pi)

y1=2-2\*cos(x);

y2=12\*((2-2\*cos(x))./(2\*cos(x)+10));

plot(x,x.\*x)

hold on

plot(x,y1,"o")

hold on

plot(x,y2,"+")

hold on

xlabel("kh");

ylabel("(k'h)^2");

legend("Central difference","Pade scheme");