

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");
```