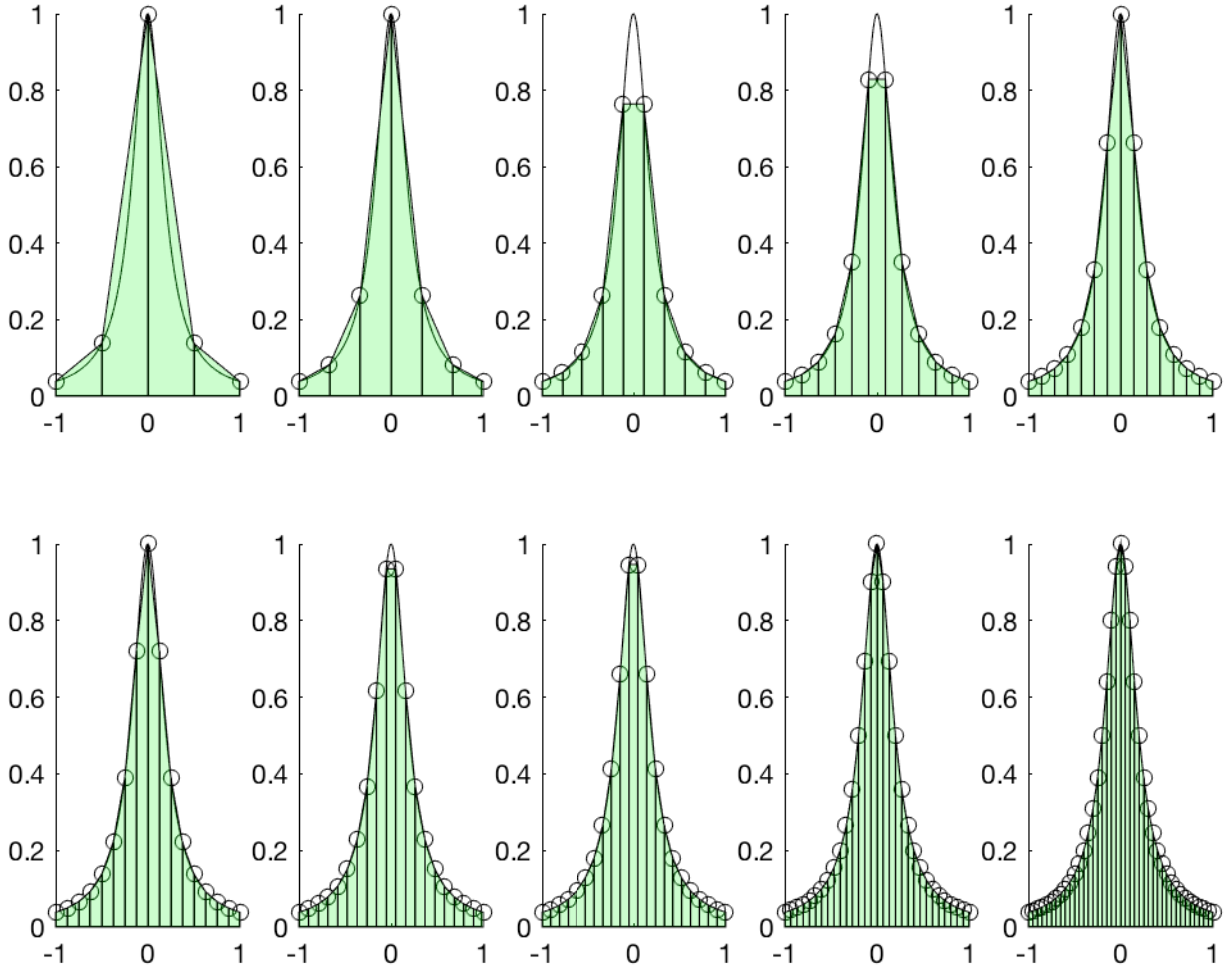
PROBLEM #1

ROSADO

```
format long
clf
close all
clear
clc

myfun=@(x) (1+25*x.^2).^(-1);
mydfun=@(x) -(1+25*x.^2).^(-2).*(50.*x);
a=-1;
b=1;
nsamples=[4,6,9,11,14,16,19,21,30,40];
frm=ceil(length(nsamples)/2);

for j=1:length(nsamples)
    N=nsamples(j);
    h=abs(b-a)/N;
    xlst=linspace(a,b,N+1);
    flst=myfun(xlst);
    Iexact=integral(myfun,a,b);

    AreaSum=0;
    cumSum=[];
    subErrors=[];
    subTrueErr=[];
    subAreas=[];
for n=1:length(xlst)-1
    [tempA,tempE,tempTe]=TrapezoidArea(xlst(n),xlst(n+1),flst(n),flst(n+1),mydfun,myfun);
    subErrors=[subErrors,tempE];
    subAreas=[subAreas,tempA];
    subTrueErr=[subTrueErr,tempTe];
    AreaSum=AreaSum+tempA;
    cumSum=[cumSum,AreaSum];
end
    subErrors;
    AreaSum;
    compError=h^2/12*(mydfun(a)-mydfun(b));
    AreaSumComp=AreaSum+compError;

    Ttab=table(xlst(1:N)',xlst(2:N+1)',subErrors', subTrueErr',subAreas',↙
cumSum','VariableNames',{'xi','xf','subErrors','subTrueErr','subAreas','ACC_Area'});
    outA=[xlst(1:N)',xlst(2:N+1)',subErrors',subTrueErr',subAreas',cumSum'];
    fileID = fopen('Comp_Trap_Out.txt','a');

fprintf(fileID,'\n \n %s %s %s %s %s %↙
s\r\n','xi','xf','subErrors','subTrueErr','subAreas','ACC_Area');
fprintf(fileID,'%d %d %d %d %d %d\r\n',outA);
fprintf(fileID,'The exact area of our function is = %d. \n The uncompensated trapezoid↙
sum is = %d.\n The compensated trapezoid sum is = %d.\n The compensation error is = %d.\n↙
The sum of the subErrors = %d.\n The sum of true SubErrors = %d.\n',Iexact,AreaSum,↙
AreaSumComp,compError,sum(subErrors),sum(subTrueErr))

fprintf('The exact area of our function is = %d. \n The uncompensated trapezoid sum is =↙
%d.\n The compensated trapezoid sum is = %d.\n The compensation error is = %d.\n The sum↙
of the subErrors = %d.\n The sum of true SubErrors = %d.\n',Iexact,AreaSum,AreaSumComp,↙
compError,sum(subErrors),sum(subTrueErr))

subplot(2,frm,j)
hold on
```

```
fplot(myfun,[a,b],'b')
stem(xlst,flst,'r')
for k=1:1:length(xlst)-1
    rx = [xlst(k) xlst(k) xlst(k+1) xlst(k+1)];
    ry = [flst(k) 0 flst(k+1) 0];
    k = convhull(rx, ry);
    fill (rx(k), ry(k), 'g','facealpha', 0.23);
end
end
fclose(fileID);
```

```
function [trapArea,OutError,OutTrueError] = TrapezoidArea(x1,x2,y1,y2,dfun,fun)
trapArea=(1/2)*abs(x2-x1)*(abs(y1)+abs(y2));
OutError=(abs(x1-x2)^2/12)*(dfun(x1)-dfun(x2));
OutTrueError=integral(fun,x1,x2)-trapArea;
end
```


1
0.8
0.6
0.4
0.2
0
-1
0
1

```
 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -5.000000e-01 0 5.000000e-01 -5.000000e-01 0
5.000000e-01 1 -8.367912e-03 9.908839e-03 9.908839e-03 -8.367912e-03
-7.475980e-03 -4.642477e-02 -4.642477e-02 -7.475980e-03 4.409814e-02
2.844828e-01
2.844828e-01 4.409814e-02 4.409814e-02 3.285809e-01 6.130637e-01
6.571618e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 6.571618e-01.
 The compensated trapezoid sum is = 6.602437e-01.
 The compensation error is = 3.081854e-03.
 The sum of the subErrors = 3.081854e-03.
 The sum of true SubErrors = -1.078015e-01.


 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -6.666667e-01 -3.333333e-01 0 3.333333e-01 6.666667e-01
-6.666667e-01 -3.333333e-01 0 3.333333e-01 6.666667e-01 1
-1.419344e-03 -8.708949e-03 1.081315e-02 1.081315e-02 -8.708949e-03
-1.419344e-03
-1.359477e-03 -8.086574e-03 -4.708948e-03 -4.708948e-03 -8.086574e-03
-1.359477e-03
2.017172e-02 5.787911e-02 2.107843e-01 2.107843e-01 5.787911e-02
2.017172e-02
2.017172e-02 7.805084e-02 2.888352e-01 4.996195e-01 5.574986e-01
5.776703e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.776703e-01.
 The compensated trapezoid sum is = 5.790400e-01.
 The compensation error is = 1.369713e-03.
 The sum of the subErrors = 1.369713e-03.
 The sum of true SubErrors = -2.831000e-02.


 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -7.777778e-01 -5.555556e-01 -3.333333e-01 -1.111111e-01
1.111111e-01
3.333333e-01 5.555556e-01 7.777778e-01 -7.777778e-01 -5.555556e-01
-3.333333e-01
-1.111111e-01 1.111111e-01 3.333333e-01 5.555556e-01 7.777778e-01 1
-3.112255e-04 -8.891006e-04 -3.301137e-03 -8.544103e-03 2.669989e-02
-8.544103e-03
-3.301137e-03 -8.891006e-04 -3.112255e-04 -3.058929e-04 -8.660246e-04
-3.186856e-03
-9.661761e-03 3.302808e-02 -9.661761e-03 -3.186856e-03 -8.660246e-04
-3.058929e-04
1.116478e-02 1.963915e-02 4.215964e-02 1.143174e-01 1.698113e-01
1.143174e-01
```

```
4.215964e-02 1.963915e-02 1.116478e-02 1.116478e-02 3.080392e-02
7.296356e-02
1.872810e-01 3.570923e-01 4.714097e-01 5.135694e-01 5.332085e-01
5.443733e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.443733e-01.
 The compensated trapezoid sum is = 5.449821e-01.
 The compensation error is = 6.087613e-04.
 The sum of the subErrors = 6.087613e-04.
 The sum of true SubErrors = 4.987012e-03.


 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -8.181818e-01 -6.363636e-01 -4.545455e-01 -2.727273e-01
-9.090909e-02
9.090909e-02 2.727273e-01 4.545455e-01 6.363636e-01 8.181818e-01
-8.181818e-01
-6.363636e-01 -4.545455e-01 -2.727273e-01 -9.090909e-02 9.090909e-02
2.727273e-01
4.545455e-01 6.363636e-01 8.181818e-01 1 -1.545227e-04 -3.500708e-04
-9.388000e-04 -2.947054e-03 -4.006532e-03 1.720148e-02 -4.006532e-03
-2.947054e-03
-9.388000e-04 -3.500708e-04 -1.545227e-04 -1.528092e-04 -3.446232e-04
-9.184726e-04
-2.888824e-03 -4.850374e-03 1.996607e-02 -4.850374e-03 -2.888824e-03
-9.184726e-04
-3.446232e-04 -1.528092e-04 8.622319e-03 1.329818e-02 2.291767e-02
4.653722e-02
1.071344e-01 1.506849e-01 1.071344e-01 4.653722e-02 2.291767e-02
1.329818e-02
8.622319e-03 8.622319e-03 2.192050e-02 4.483817e-02 9.137538e-02
1.985098e-01
3.491947e-01 4.563291e-01 5.028663e-01 5.257839e-01 5.390821e-01
5.477044e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.477044e-01.
 The compensated trapezoid sum is = 5.481120e-01.
 The compensation error is = 4.075179e-04.
 The sum of the subErrors = 4.075179e-04.
 The sum of true SubErrors = 1.655861e-03.


 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -8.571429e-01 -7.142857e-01 -5.714286e-01 -4.285714e-01
-2.857143e-01
-1.428571e-01 0 1.428571e-01 2.857143e-01 4.285714e-01 5.714286e-01
7.142857e-01 8.571429e-01 -8.571429e-01 -7.142857e-01 -5.714286e-01
-4.285714e-01
-2.857143e-01 -1.428571e-01 0 1.428571e-01 2.857143e-01 4.285714e-01
5.714286e-01 7.142857e-01 8.571429e-01 1 -6.852472e-05 -1.267090e-04
```

-2.576772e-04 -5.867848e-04 -1.462024e-03 -2.698763e-03 5.326272e-03
5.326272e-03
-2.698763e-03 -1.462024e-03 -5.867848e-04 -2.576772e-04 -1.267090e-04
-6.852472e-05
-6.807079e-05 -1.256171e-04 -2.547553e-04 -5.783548e-04 -1.443895e-03
-2.823055e-03
5.324028e-03 5.324028e-03 -2.823055e-03 -1.443895e-03 -5.783548e-04
-2.547553e-04
-1.256171e-04 -6.807079e-05 6.435345e-03 8.880971e-03 1.298798e-02
2.056882e-02
3.626366e-02 7.078723e-02 1.187259e-01 1.187259e-01 7.078723e-02
3.626366e-02
2.056882e-02 1.298798e-02 8.880971e-03 6.435345e-03 6.435345e-03
1.531632e-02
2.830430e-02 4.887312e-02 8.513677e-02 1.559240e-01 2.746499e-01
3.933757e-01
4.641630e-01 5.004266e-01 5.209954e-01 5.339834e-01 5.428644e-01
5.492997e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.492997e-01.
 The compensated trapezoid sum is = 5.495513e-01.
 The compensation error is = 2.515799e-04.
 The sum of the subErrors = 2.515799e-04.
 The sum of true SubErrors = 6.056202e-05.

 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -8.750000e-01 -7.500000e-01 -6.250000e-01 -5.000000e-01
-3.750000e-01
-2.500000e-01 -1.250000e-01 0 1.250000e-01 2.500000e-01 3.750000e-01
5.000000e-01 6.250000e-01 7.500000e-01 8.750000e-01 -8.750000e-01
-7.500000e-01
-6.250000e-01 -5.000000e-01 -3.750000e-01 -2.500000e-01 -1.250000e-01
0
1.250000e-01 2.500000e-01 3.750000e-01 5.000000e-01 6.250000e-01
7.500000e-01
8.750000e-01 1 -4.412564e-05 -7.478311e-05 -1.358667e-04 -2.682190e-04
-5.780013e-04 -1.281380e-03 -1.729540e-03 4.208223e-03 4.208223e-03
-1.729540e-03
-1.281380e-03 -5.780013e-04 -2.682190e-04 -1.358667e-04 -7.478311e-05
-4.412564e-05
-4.390520e-05 -7.431369e-05 -1.347823e-04 -2.655184e-04 -5.713303e-04
-1.274351e-03
-1.842850e-03 4.276043e-03 4.276043e-03 -1.842850e-03 -1.274351e-03
-5.713303e-04
-2.655184e-04 -1.347823e-04 -7.431369e-05 -4.390520e-05 5.507027e-03
7.252558e-03
9.954893e-03 1.442620e-02 2.246152e-02 3.823107e-02 6.933406e-02
1.074438e-01
1.074438e-01 6.933406e-02 3.823107e-02 2.246152e-02 1.442620e-02

9.954893e-03
7.252558e-03 5.507027e-03 5.507027e-03 1.275959e-02 2.271448e-02
3.714068e-02
5.960220e-02 9.783328e-02 1.671673e-01 2.746112e-01 3.820550e-01
4.513890e-01
4.896201e-01 5.120816e-01 5.265078e-01 5.364627e-01 5.437153e-01
5.492223e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.492223e-01.
 The compensated trapezoid sum is = 5.494149e-01.
 The compensation error is = 1.926159e-04.
 The sum of the subErrors = 1.926159e-04.
 The sum of true SubErrors = 1.379832e-04.

 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -8.947368e-01 -7.894737e-01 -6.842105e-01 -5.789474e-01
-4.736842e-01
-3.684211e-01 -2.631579e-01 -1.578947e-01 -5.263158e-02 5.263158e-02
1.578947e-01
2.631579e-01 3.684211e-01 4.736842e-01 5.789474e-01 6.842105e-01
7.894737e-01
8.947368e-01 -8.947368e-01 -7.894737e-01 -6.842105e-01 -5.789474e-01
-4.736842e-01
-3.684211e-01 -2.631579e-01 -1.578947e-01 -5.263158e-02 5.263158e-02
1.578947e-01
2.631579e-01 3.684211e-01 4.736842e-01 5.789474e-01 6.842105e-01
7.894737e-01
8.947368e-01 1 -2.525015e-05 -3.901627e-05 -6.317676e-05 -1.080842e-04
-1.967918e-04 -3.806245e-04 -7.473757e-04 -1.137870e-03 6.411486e-04
4.250673e-03
6.411486e-04 -1.137870e-03 -7.473757e-04 -3.806245e-04 -1.967918e-04
-1.080842e-04
-6.317676e-05 -3.901627e-05 -2.525015e-05 -2.516218e-05 -3.885183e-05
-6.285138e-05
-1.074019e-04 -1.952985e-04 -3.774972e-04 -7.440537e-04 -1.165693e-03
5.471347e-04
4.483890e-03 5.471347e-04 -1.165693e-03 -7.440537e-04 -3.774972e-04
-1.952985e-04
-1.074019e-04 -6.285138e-05 -3.885183e-05 -2.516218e-05 4.528905e-03
5.678687e-03
7.317117e-03 9.754385e-03 1.357446e-02 1.994294e-02 3.124960e-02
5.169299e-02
8.164601e-02 9.844560e-02 8.164601e-02 5.169299e-02 3.124960e-02
1.994294e-02
1.357446e-02 9.754385e-03 7.317117e-03 5.678687e-03 4.528905e-03
4.528905e-03
1.020759e-02 1.752471e-02 2.727909e-02 4.085355e-02 6.079649e-02
9.204609e-02
1.437391e-01 2.253851e-01 3.238307e-01 4.054767e-01 4.571697e-01

```
4.884193e-01
5.083622e-01 5.219367e-01 5.316911e-01 5.390082e-01 5.446869e-01
5.492158e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.492158e-01.
 The compensated trapezoid sum is = 5.493524e-01.
 The compensation error is = 1.365919e-04.
 The sum of the subErrors = 1.365919e-04.
 The sum of true SubErrors = 1.445394e-04.


 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -9.047619e-01 -8.095238e-01 -7.142857e-01 -6.190476e-01
-5.238095e-01
-4.285714e-01 -3.333333e-01 -2.380952e-01 -1.428571e-01 -4.761905e-02
4.761905e-02
1.428571e-01 2.380952e-01 3.333333e-01 4.285714e-01 5.238095e-01
6.190476e-01
7.142857e-01 8.095238e-01 9.047619e-01 -9.047619e-01 -8.095238e-01
-7.142857e-01
-6.190476e-01 -5.238095e-01 -4.285714e-01 -3.333333e-01 -2.380952e-01
-1.428571e-01
-4.761905e-02 4.761905e-02 1.428571e-01 2.380952e-01 3.333333e-01
4.285714e-01
5.238095e-01 6.190476e-01 7.142857e-01 8.095238e-01 9.047619e-01 1
-1.830783e-05 -2.703186e-05 -4.143083e-05 -6.631111e-05 -1.114937e-04
-1.975116e-04
-3.647124e-04 -6.573043e-04 -8.272217e-04 7.554875e-04 3.223489e-03
7.554875e-04
-8.272217e-04 -6.573043e-04 -3.647124e-04 -1.975116e-04 -1.114937e-04
-6.631111e-05
-4.143083e-05 -2.703186e-05 -1.830783e-05 -1.825606e-05 -2.694113e-05
-4.126434e-05
-6.599051e-05 -1.108495e-04 -1.962034e-04 -3.623890e-04 -6.567895e-04
-8.539407e-04
7.053518e-04 3.368517e-03 7.053518e-04 -8.539407e-04 -6.567895e-04
-3.623890e-04
-1.962034e-04 -1.108495e-04 -6.599051e-05 -4.126434e-05 -2.694113e-05
-1.825606e-05
4.049968e-03 4.957835e-03 6.201288e-03 7.962562e-03 1.055950e-02
1.457467e-02
2.112086e-02 3.230485e-02 5.123134e-02 7.659591e-02 9.012876e-02
7.659591e-02
5.123134e-02 3.230485e-02 2.112086e-02 1.457467e-02 1.055950e-02
7.962562e-03
6.201288e-03 4.957835e-03 4.049968e-03 4.049968e-03 9.007803e-03
1.520909e-02
2.317165e-02 3.373115e-02 4.830583e-02 6.942668e-02 1.017315e-01
1.529629e-01
2.295588e-01 3.196875e-01 3.962835e-01 4.475148e-01 4.798197e-01
```

```
5.009405e-01
5.155152e-01 5.260747e-01 5.340372e-01 5.402385e-01 5.451964e-01
5.492463e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.492463e-01.
 The compensated trapezoid sum is = 5.493581e-01.
 The compensation error is = 1.118133e-04.
 The sum of the subErrors = 1.118133e-04.
 The sum of true SubErrors = 1.139721e-04.


 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -9.333333e-01 -8.666667e-01 -8.000000e-01 -7.333333e-01
-6.666667e-01
-6.000000e-01 -5.333333e-01 -4.666667e-01 -4.000000e-01 -3.333333e-01
-2.666667e-01
-2.000000e-01 -1.333333e-01 -6.666667e-02 0 6.666667e-02 1.333333e-01
2.000000e-01 2.666667e-01 3.333333e-01 4.000000e-01 4.666667e-01
5.333333e-01
6.000000e-01 6.666667e-01 7.333333e-01 8.000000e-01 8.666667e-01
9.333333e-01
-9.333333e-01 -8.666667e-01 -8.000000e-01 -7.333333e-01 -6.666667e-01
-6.000000e-01
-5.333333e-01 -4.666667e-01 -4.000000e-01 -3.333333e-01 -2.666667e-01
-2.000000e-01
-1.333333e-01 -6.666667e-02 0 6.666667e-02 1.333333e-01 2.000000e-01
2.666667e-01 3.333333e-01 4.000000e-01 4.666667e-01 5.333333e-01
6.000000e-01
6.666667e-01 7.333333e-01 8.000000e-01 8.666667e-01 9.333333e-01 1
-5.919246e-06 -7.716669e-06 -1.023216e-05 -1.382642e-05 -1.907924e-05
-2.694311e-05
-3.901086e-05 -5.796364e-05 -8.821068e-05 -1.362297e-04 -2.074740e-04
-2.859259e-04
-2.575060e-04 1.834320e-04 1.000000e-03 1.000000e-03 1.834320e-04
-2.575060e-04
-2.859259e-04 -2.074740e-04 -1.362297e-04 -8.821068e-05 -5.796364e-05
-3.901086e-05
-2.694311e-05 -1.907924e-05 -1.382642e-05 -1.023216e-05 -7.716669e-06
-5.919246e-06
-5.911242e-06 -7.704926e-06 -1.021456e-05 -1.379942e-05 -1.903682e-05
-2.687493e-05
-3.889920e-05 -5.777963e-05 -8.791592e-05 -1.358178e-04 -2.072077e-04
-2.872557e-04
-2.644778e-04 1.734868e-04 1.016778e-03 1.016778e-03 1.734868e-04
-2.644778e-04
-2.872557e-04 -2.072077e-04 -1.358178e-04 -8.791592e-05 -5.777963e-05
-3.889920e-05
-2.687493e-05 -1.903682e-05 -1.379942e-05 -1.021456e-05 -7.704926e-06
-5.911242e-06
2.745466e-03 3.148808e-03 3.646178e-03 4.268477e-03 5.059986e-03
```

6.085627e-03
7.442922e-03 9.282003e-03 1.183908e-02 1.549020e-02 2.082353e-02
2.866667e-02
3.974359e-02 5.307692e-02 6.333333e-02 6.333333e-02 5.307692e-02
3.974359e-02
2.866667e-02 2.082353e-02 1.549020e-02 1.183908e-02 9.282003e-03
7.442922e-03
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2.745466e-03 5.894274e-03 9.540451e-03 1.380893e-02 1.886891e-02
2.495454e-02
3.239746e-02 4.167947e-02 5.351855e-02 6.900874e-02 8.983227e-02
1.184989e-01
1.582425e-01 2.113195e-01 2.746528e-01 3.379861e-01 3.910630e-01
4.308066e-01
4.594733e-01 4.802968e-01 4.957870e-01 5.076261e-01 5.169081e-01
5.243510e-01
5.304367e-01 5.354966e-01 5.397651e-01 5.434113e-01 5.465601e-01
5.493056e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.493056e-01.
 The compensated trapezoid sum is = 5.493604e-01.
 The compensation error is = 5.478852e-05.
 The sum of the subErrors = 5.478852e-05.
 The sum of true SubErrors = 5.473722e-05.

 xi xf subErrors subTrueErr subAreas ACC_Area
-1 -9.500000e-01 -9.000000e-01 -8.500000e-01 -8.000000e-01
-7.500000e-01
-7.000000e-01 -6.500000e-01 -6.000000e-01 -5.500000e-01 -5.000000e-01
-4.500000e-01
-4.000000e-01 -3.500000e-01 -3.000000e-01 -2.500000e-01 -2.000000e-01
-1.500000e-01
-1.000000e-01 -5.000000e-02 0 5.000000e-02 1.000000e-01 1.500000e-01
2.000000e-01 2.500000e-01 3.000000e-01 3.500000e-01 4.000000e-01
4.500000e-01
5.000000e-01 5.500000e-01 6.000000e-01 6.500000e-01 7.000000e-01
7.500000e-01
8.000000e-01 8.500000e-01 9.000000e-01 9.500000e-01 -9.500000e-01
-9.000000e-01
-8.500000e-01 -8.000000e-01 -7.500000e-01 -7.000000e-01 -6.500000e-01
-6.000000e-01
-5.500000e-01 -5.000000e-01 -4.500000e-01 -4.000000e-01 -3.500000e-01
-3.000000e-01
-2.500000e-01 -2.000000e-01 -1.500000e-01 -1.000000e-01 -5.000000e-02
0
5.000000e-02 1.000000e-01 1.500000e-01 2.000000e-01 2.500000e-01
3.000000e-01
3.500000e-01 4.000000e-01 4.500000e-01 5.000000e-01 5.500000e-01

6.000000e-01
6.500000e-01 7.000000e-01 7.500000e-01 8.000000e-01 8.500000e-01
9.000000e-01
9.500000e-01 1 -2.414913e-06 -2.937062e-06 -3.604964e-06 -4.468854e-06
-5.599605e-06 -7.098498e-06 -9.112073e-06 -1.185476e-05 -1.564304e-05
-2.094535e-05
-2.844908e-05 -3.912920e-05 -5.424063e-05 -7.495069e-05 -1.007313e-04
-1.242440e-04
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2.053057e-04
-2.666667e-05 -1.191667e-04 -1.242440e-04 -1.007313e-04 -7.495069e-05
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-9.112073e-06
-7.098498e-06 -5.599605e-06 -4.468854e-06 -3.604964e-06 -2.937062e-06
-2.414913e-06
-2.413102e-06 -2.934658e-06 -3.601734e-06 -4.464459e-06 -5.593549e-06
-7.090039e-06
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-1.205891e-04
-1.246533e-04 -1.007375e-04 -7.485599e-05 -5.414510e-05 -3.905546e-05
-2.839671e-05
-2.090919e-05 -1.561819e-05 -1.183760e-05 -9.100099e-06 -7.090039e-06
-5.593549e-06
-4.464459e-06 -3.601734e-06 -2.934658e-06 -2.413102e-06 2.022546e-03
2.237479e-03
2.487946e-03 2.782064e-03 3.130339e-03 3.546543e-03 4.048955e-03
4.662162e-03
5.419708e-03 6.367984e-03 7.571987e-03 9.123711e-03 1.115385e-02
1.384615e-02
1.744841e-02 2.225610e-02 2.850000e-02 3.600000e-02 4.352941e-02
4.852941e-02
4.852941e-02 4.352941e-02 3.600000e-02 2.850000e-02 2.225610e-02
1.744841e-02
1.384615e-02 1.115385e-02 9.123711e-03 7.571987e-03 6.367984e-03
5.419708e-03
4.662162e-03 4.048955e-03 3.546543e-03 3.130339e-03 2.782064e-03
2.487946e-03
2.237479e-03 2.022546e-03 2.022546e-03 4.260025e-03 6.747971e-03
9.530035e-03
1.266037e-02 1.620692e-02 2.025587e-02 2.491803e-02 3.033774e-02
3.670573e-02
4.427771e-02 5.340142e-02 6.455527e-02 7.840142e-02 9.584983e-02
1.181059e-01
1.466059e-01 1.826059e-01 2.261353e-01 2.746648e-01 3.231942e-01
3.667236e-01

```
4.027236e-01 4.312236e-01 4.534797e-01 4.709281e-01 4.847742e-01
4.959281e-01
5.050518e-01 5.126238e-01 5.189918e-01 5.244115e-01 5.290736e-01
5.331226e-01
5.366691e-01 5.397995e-01 5.425815e-01 5.450695e-01 5.473070e-01
5.493295e-01
The exact area of our function is = 5.493603e-01.
 The uncompensated trapezoid sum is = 5.493295e-01.
 The compensated trapezoid sum is = 5.493603e-01.
 The compensation error is = 3.081854e-05.
 The sum of the subErrors = 3.081854e-05.
 The sum of true SubErrors = 3.080487e-05.
```

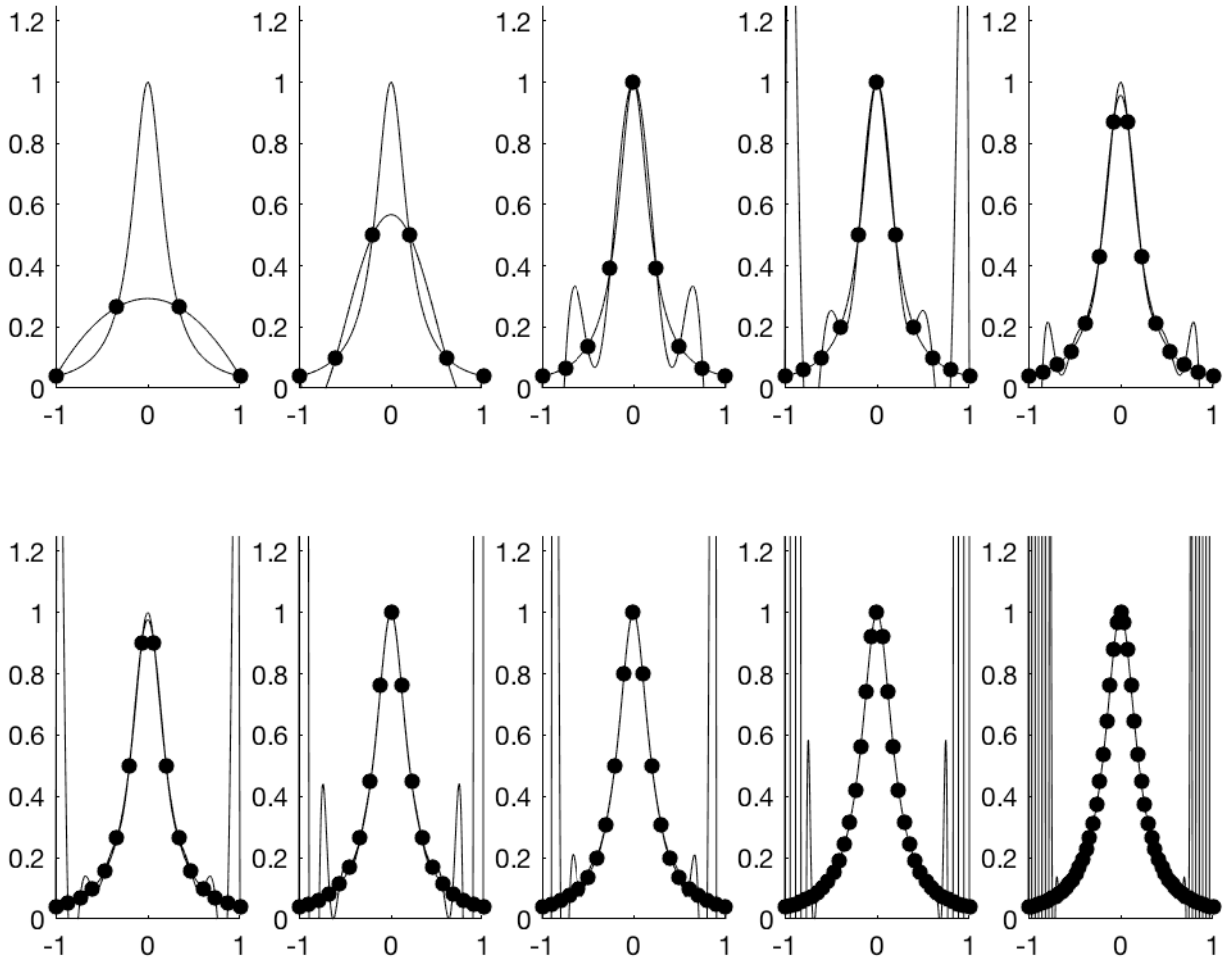
PROBLEM #2:
REGULAR INTERPOLATION

```
%REGULAR INTERPOLATION
clf
close all
clc
clear
myfun=@(x) (1+25*x.^2).^(-1);
a=-1;
b=1;
nsamples=[4,6,9,11,14,16,19,21,35,55];
frm=ceil(length(nsamples)/2);
choose=input('Equidistant[1] or Tchebyshev[2]: ');
for k=1:length(nsamples)
Np1=nsamples(k);
h=abs(b-a)/(Np1-1);
xlst=linspace(a,b,Np1);
flst=myfun(xlst);

clst=newtonCoeff(xlst,flst);
pxlst=linspace(a,b,1000);
pylst=newtonP(pxlst,xlst,clst);

xTcheb=(1/2)*(a+b)+(1/2)*(b-a)*cos( (2* (0:Np1-1)+1) / (2*Np1) * pi );
fTcheb=myfun(xTcheb);
cTcheb=newtonCoeff(xTcheb,fTcheb);
yTcheb=newtonP(pxlst,xTcheb,cTcheb);

if choose == 2
subplot(2,frm,k)
hold on
scatter(xTcheb,fTcheb,'filled','b')
plot(pxlst,yTcheb,'r')
plot(pxlst,myfun(pxlst),'Black')
ylim([0 1.25])
else
subplot(2,frm,k)
hold on
scatter(xlst,flst,'filled','b')
plot(pxlst,pylst,'r')
plot(pxlst,myfun(pxlst),'Black')
ylim([0 1.25])
end

end

%QUESTION #3
%For the interpolation using equidistant points, it looks like that
%convergence will not occur near and at the endpoints.

%For the interpolation using Tchebyshev points, convergence is much better,
%but I noticed that for more points, there is some disparity at x=-1.
```

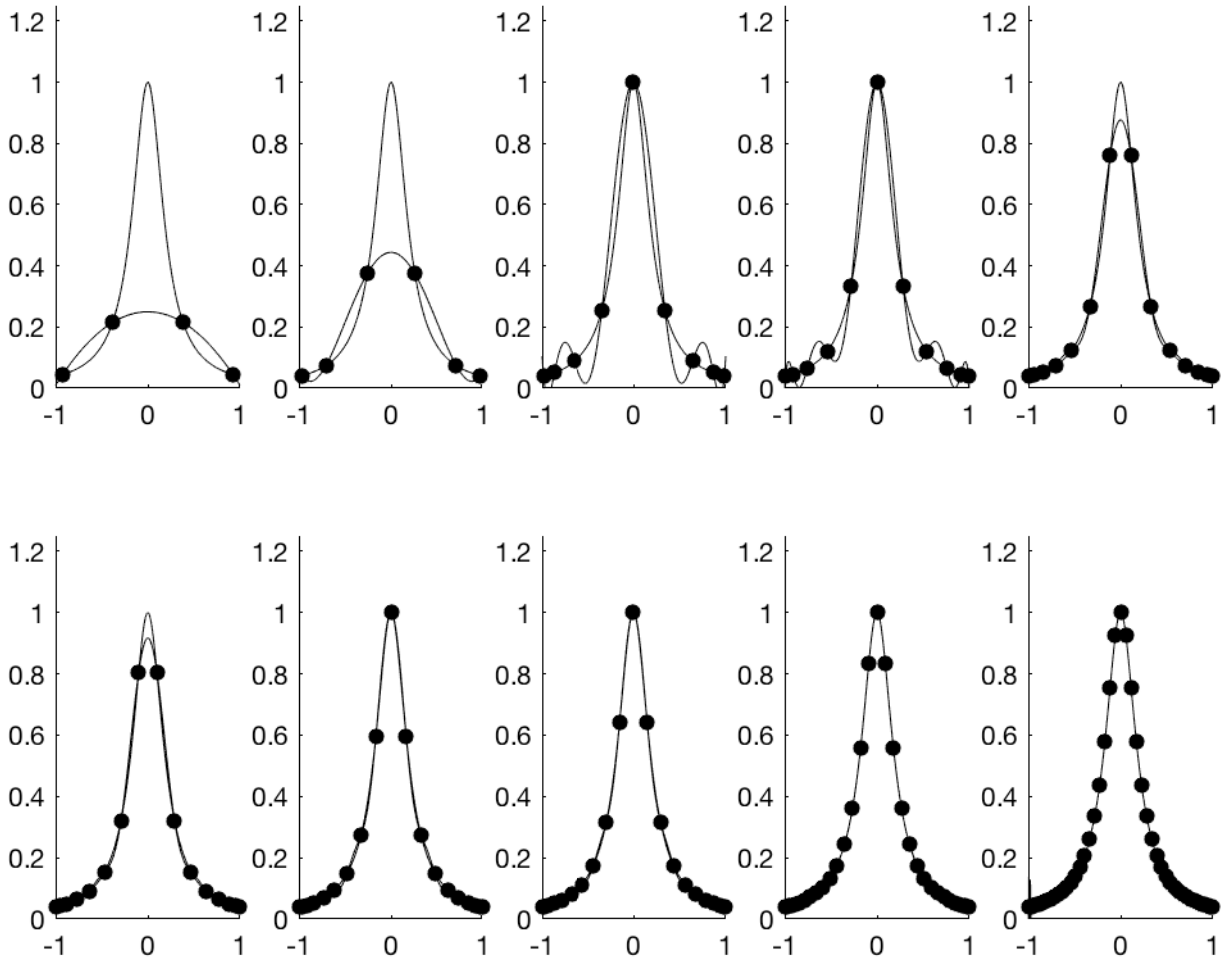
```
%Newton Coefficients functions
function c_out = newtonCoeff(xlst,ylst)
flst=ylst;
listlenX=length(xlst);
        for k=1:listlenX
            temp1=flst(k);
                for n=k:listlenX-1
                    temp2=flst(n+1);
                    flst(n+1)=diffq(xlst(n-k+1),xlst(n+1),temp1,temp2);
                    temp1=temp2;
                end
        end
 c_out=flst;
end
```

```
%newton polynomial computation
function y_out = newtonP(xin,xlst,nCoeff)
sum=0;
for k=1:length(xlst)
    prod=nCoeff(k);
    for j=1:k-1
        prod=prod.*(xin-xlst(j));
    end
    sum=sum+prod;
end
y_out=sum;
end
```

EQUIDISTANT INTERPOLATION



INTERPOLATION USING TCHEBYSHEV POINTS

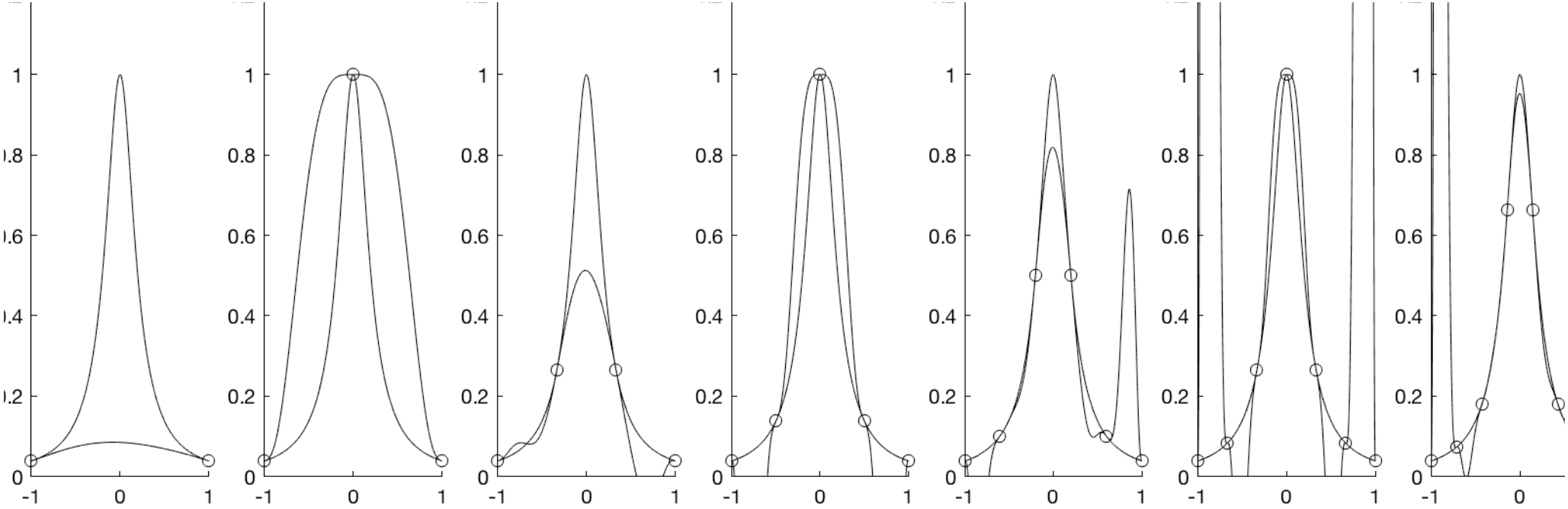


PROBLEM #4: HERMITE INTERPOLATION

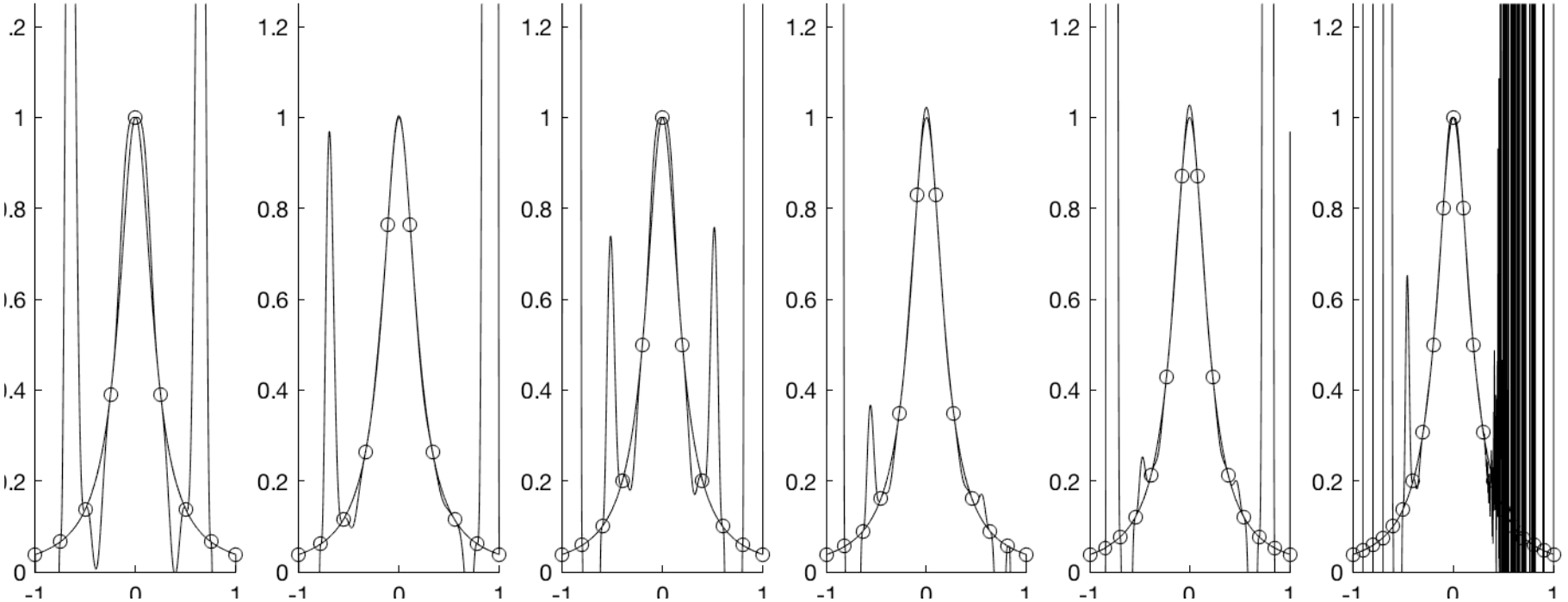
```
%MAIN HERMITE INTERPOLATION
clf
close all
clear
clc
format long

myfun=@(x) (1+25*x.^2).^(-1);
mydfun=@(x) -(1+25*x.^2).^(-2).*(50.*x);
myddfun=@(x) 2*(1+25*x.^2).^(-3).*(50.*x).*(50.*x)-50*(1+25*x.^2).^(-2);
a=-1;
b=1;
nsamples=[2,3,4,5,6,7,8,9,10,11,12,14,21];
choose=input('Equidistant [1] or Tchebyshev[2]? ');
frm=ceil(length(nsamples)/2);
for k=1:length(nsamples)
N=nsamples(k);
if choose == 1
    xlst=linspace(a,b,N);
    ylst=myfun(xlst);
    ydlst=mydfun(xlst);
    yddlst=mydfun(xlst);
elseif choose == 2
    xlst=(1/2)*(a+b)+(1/2)*(b-a)*cos( (2* (0:N-1)+1) / (2*N) * pi );
    ylst=myfun(xlst);
    ydlst=mydfun(xlst);
    yddlst=mydfun(xlst);
end
%Number Of points
nPts=length(xlst);
%Order of highest derivative
mOrd=2;

%Degree of polynomial
polDeg=nPts*(mOrd+1)-1;

Xlst=[];
Ylst=[];
YDlst=[];
YDDlst=[];
for n=1:nPts
    Xlst=[Xlst,repmat(xlst(n),mOrd+1,1)'];
    Ylst=[Ylst,repmat(ylst(n),mOrd+1,1)'];
    YDlst=[YDlst,repmat(ydlst(n),mOrd+1,1)'];
    YDDlst=[YDDlst,repmat(yddlst(n)./2,mOrd+1,1)'];
end

coeffs = hermiteInterp(Xlst,Ylst,YDlst,YDDlst,polDeg);

xvals=linspace(-1,1,1000);
yvals=newtonP(xvals,Xlst(1:polDeg+1),coeffs);

subplot(2,frm,k)
hold on
plot(xvals,yvals,'b')
scatter(xlst,ylst,'r')
fplot(myfun,[a,b],'Black')
%pbaspect([2 2 2])
```

```
ylim([0 1.25])
end

%PROBLEM #4
%For equidistant points, there is no convergence at the endpoints for
%Hermite interpolation.

%For Tchebyshev points there is convergence, but I noticed some disparity
%at x=-1 for more points.
```

```
%HERMITE INTERPOLATION FUNCTION
function coeffs = hermiteInterp(Xlst,Ylst,YDlst,YDDlst,polDeg)
Nmat=zeros(polDeg+1);
Nmat(:,1)=Xlst';
Nmat(:,2)=Ylst';
Nmat(:,3)=YDlst';
Nmat(:,4)=YDDlst';
Nmat;
for j=1:polDeg
    for k=1:length(Xlst)-j
        if Nmat(k,1) ~= Nmat(k+j,1)
            Nmat(k,j+2)=(Nmat(k,j+1)-Nmat(k+1,j+1))/((Nmat(k,1)-Nmat(k+j,1)));
        end
    end
end
coeffs=Nmat(1,2:polDeg+2);
end
```



HERMITE INTERPOLATION USING EQUIDISTANT POINTS



HERMITE INTERPOLATION USING TCHEBYSHEV POINTS