Python Console Output:

runfile('/Users/andrewalferman/ME526\_HW\_1\_6BC', wdir='/Users/andrewalferman')

Note: Blue is actual values, green is estimated values

        

Python Code:

#!/usr/bin/env python3

# -\*- coding: utf-8 -\*-

"""

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"""

#Importing Commands

import numpy as np

import matplotlib.pyplot as plt

#Create an array of all of the desired datapoints

xv=np.linspace(0,8,33)

#Create an array of all of the exact solutions to the function

def solutions(xv):

exs=[]

for i in xv:

exs.append(np.sin((4-i)\*(4+i)))

return exs

#Create an array with all of the estimated values of f''

def estdvalues(xv):

estd=[]

exs=solutions(xv)

for i in range(len(xv)):

if i==0:

estd.append((exs[i]-2\*exs[i+1]+exs[i+2])/((8/len(xv))\*\*2))

elif i==(len(xv)-1):

estd.append((exs[i]-2\*exs[i-1]+exs[i-2])/((8/len(xv))\*\*2))

else:

estd.append((1.5\*exs[i+1]-3\*exs[i]+1.5\*exs[i-1])/((8/len(xv))\*\*2))

return estd

#Create an array of the actual f'' values

def actvalues(xv):

actfd=[]

for i in range(len(xv)):

actfd.append(-4\*xv[i]\*\*2\*np.sin((4-xv[i])\*(4+xv[i]))-2\*np.cos((4-xv[i])\*(4+xv[i])))

return actfd

#Create an array of the absolute error

def abserror(xv):

actfd=actvalues(xv)

estd=estdvalues(xv)

erra=[]

for i in range(len(xv)):

erra.append(np.absolute(actfd[i]-estd[i]))

return erra

#Cycle through error of different grid spacings

xh=[10.0\*\*-3,5\*10.0\*\*-3,10.0\*\*-2,5\*10.0\*\*-2,10.0\*\*-1,0.25]

def gerror(xh):

for i in xh:

nerra=[]

xvn=np.linspace(0,8,(8/i)+1)

nerra=abserror(xvn)

plt.title("Graph of spacing {}:".format(i))

plt.xlabel("X value")

plt.ylabel("Y value")

plt.loglog(xvn,nerra)

plt.show()

#Plot the actual vs. estimated values of f''

print("Note: Blue is actual values, green is estimated values")

plt.plot(xv,actvalues(xv))

plt.plot(xv,estdvalues(xv))

plt.xlabel("X value")

plt.ylabel("Second Derivative Value")

plt.title("Second Derivative Values")

plt.show()

#Plot the absolute error

plt.plot(xv,abserror(xv))

plt.xlabel("X value")

plt.ylabel("Absolute Error Value")

plt.title("Absolute Error")

plt.show()

#Plot the error on a log-log plot

gerror(xh)