EGR 103L – Fall 2021

Laboratory 12 - Interpolations

Tyler Klimas (TK206)
Lab Section 9, Thursday 3:30-6:30
12/3/21 5:00 PM

I have adhered to the Duke Community Standard in completing this assignment. I understand that a violation of the Standard can result in failure of this assignment, failure of this course, and/or suspension from Duke University.

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A Codes

A.1 Chapra 18.9

```python
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
"""
@author: tylerklimas
[chapra_18_009.py]
[Tyler Klimas]
[11-29-21]


I understand and have adhered to all the tenets of the Duke Community Standard
in creating this code.
Signed: [TK206]
"""

import numpy as np
from scipy.interpolate import CubicSpline
from scipy.interpolate import interp1d
import matplotlib.pyplot as plt


t = np.array([0,8,16,24,32,40])
o = np.array([14.621, 11.843, 9.870, 8.418, 7.305, 6.413])

lin = interp1d(t, o, kind='linear')
poly = interp1d(t, o, kind=5)
cub = CubicSpline(t, o)

o27 = lin(27)
o275 = poly(27)
o27s = cub(27)
print(o27, o275, o27s)
x = np.linspace(t.min(), t.max(), 100)

fig = plt.figure(num=1, clear=True)
ax =fig.add_subplot(1,1,1)
ax.plot(t, o, 'mo')
ax.plot(x, lin(x), 'r', label='Linear')
ax.plot(x, poly(x), 'g--', label = 'Polynomial')
ax.plot(x, cub(x), 'b--', label= 'Cubic Spline')
plt.legend(loc='best')

fig.savefig('chapra_18_009.png')
```

A.2 Chapra 18.10

```python
#!/usr/bin/env python3
# -*- coding: utf-8 -*-
"""
@author: tylerklimas
[chapra_18_010.py]
[Tyler Klimas]
[11-29-21]


I understand and have adhered to all the tenets of the Duke Community Standard
in creating this code.
Signed: [TK206]
"""

import numpy as np
from scipy.interpolate import CubicSpline
from scipy.interpolate import interp1d
import matplotlib.pyplot as plt

x = np.array([0,2,4,7,10,12])
y = np.array([20,20,12,7,6,6])

cub = CubicSpline(x, y)
clamp = CubicSpline(x, y, bc_type = 'clamped')

xmod = np.linspace(x.min(), x.max(), 100)

y1 = cub(1.5)
y2 = clamp(1.5)
print(y1, y2)

fig = plt.figure(num=1, clear=True)
ax =fig.add_subplot(1,1,1)

ax.plot(x, y, 'mo')
ax.plot(xmod, cub(xmod), 'r')
ax.plot(xmod, clamp(xmod), 'b--')

plt.legend(['Data', 'Cubic Spline', 'Clamped'], loc='best')

fig.savefig('chapra_18_010_plot.png')
```

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A.3 Chapra 18.14

```python
1  #!/usr/bin/env python3
2  # -*- coding: utf-8 -*-
3  """
4  @author: tylerklimas
5  [chapra_18_014.py]
6  [Tyler Klimas]
7  [11-29-21]
8
9
10 I understand and have adhered to all the tenets of the Duke Community Standard
11 in creating this code.
12 Signed: [TK206]
13 """
14
15 import numpy as np
16 from scipy.interpolate import CubicSpline
17 from scipy.interpolate import interp2d
18 import matplotlib.pyplot as plt
19 from mpl_toolkits.mplot3d import axes3d
20
21 def fun(x, y):
22     t = 2 + x - y + 2*x**2 + 2*x*y + y**2
23     return t
24
25 x = np.linspace(-2, 0, 9)
26 y = np.linspace(0,3,9)
27
28 x1, y1 = np.meshgrid(x, y)
29
30 t1 = fun(x1, y1)
31
32 tinterp = interp2d(x, y, t1, kind='linear')
33 spline = interp2d(x, y, t1, kind = 'cubic')
34
35 real = fun(-1.63, 1.627)
36 print(real)
37 pred = tinterp(-1.63, 1.627)[0]
38 print(pred)
39
40 per = ((pred - real)/real) * 100
41 print(per)
42
43 pred2 = spline(-1.63, 1.627)[0]
44 print(pred2)
45
46 per2 = abs(((pred2 - real)/real) * 100)
47 print(per2)
```
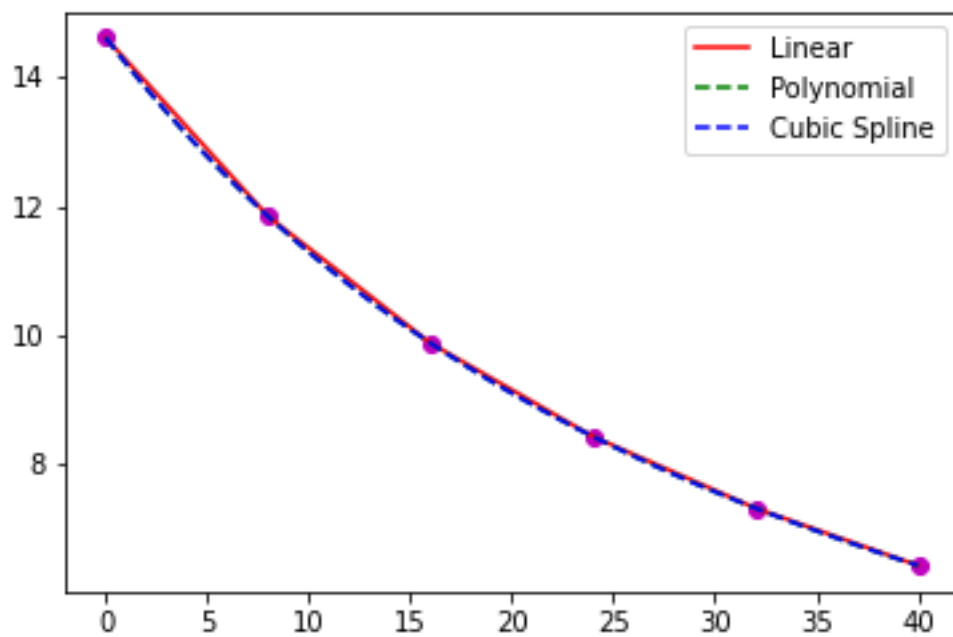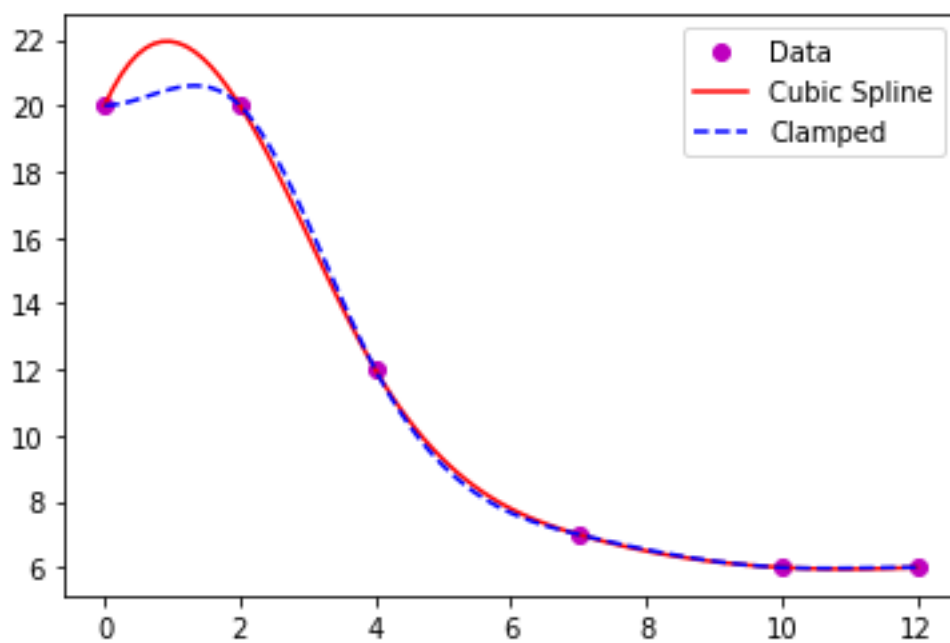
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B   Figures

Figure 1: Chapra 18.9

Figure 2: Chapra 18.10