a3q5_YOU

November 4, 2021

1 A3-Q5: Time of Death

[26]:
```
import numpy as np
from scipy.integrate import solve_ivp
import matplotlib.pyplot as plt
```

1.1 (a) Dynamics Function

[87]:
```
# Dynamics function
# === YOUR CODE HERE ===
def ta(t):
    if (t%24 < 7):
        return 15
    elif (t%24 < 7.5):
        return 15+7*((t%24-7)/0.5)
    elif (t%24 < 18):
        return 22
    elif (t%24 < 20):
        return 22-7*((t%24-18)/2)
    else:
        return 15
def dTdt_T(t,T,a,b):
    result = -0.15*(T-ta(t))+(a+2*b)/100
    return result
def dAdt_T(T,a):
    result = 0
    if (T >= 29 and T <= 45):
        result = 0.0015*np.square(T-29)*(1-np.exp([0.08*(T-45)])[0])*a*(30-a)
    return result
def dBdt_T(T,b):
    result = 0
    if (T >= 13 and T <= 26):
        result = 0.002*np.square(T-13)*(1-np.exp([0.05*(T-26)])[0])*b*(20-b)
    return result

def dynamics(init_t,final_t):
    init_A = 1
```

```
    init_B = 1
    init_T = 37.5
    def dzdt(t, abt):
        a = abt[0]
        b = abt[1]
        T = abt[2]
        dadt = dAdt_T(T,a)
        dbdt = dBdt_T(T,b)
        dtdt = dTdt_T(t,T,a,b)
        return [dadt,dbdt,dtdt]
    def dAdt(t,abt):
        return dzdt(t,abt)[0]
    def dBdt(t,abt):
        return dzdt(t,abt)[1]
    def dTdt(t,abt):
        return dzdt(t,abt)[2]
    abt = np.array([init_A,init_B,init_T])

    final = solve_ivp(dzdt,[init_t,final_t],abt)
    return final
```

[ ]:

1.2 (b) Run the simulation

[103]:
```
# === YOUR CODE HERE ===
import pandas as pd
timeFound = 10.75
values = np.arange(-24,0,1)
data = []
for x in values:
    result = dynamics(x,timeFound)
    #print(result)
    A = result.y[0]
    B = result.y[1]
    T = result.y[2]
    data.append([x, A[len(A)-1], B[len(B)-1], T[len(T)-1]])
pd.DataFrame(data, columns=["time of death (in hours before midnight)","A when␣
 ↪found","B when found","T when found"])
```

[103]:

	time of death (in hours before midnight)	A when found	B when found	\
0	-24	4.602313	19.999878	
1	-23	4.602313	19.999574	
2	-22	4.602313	19.995750	
3	-21	4.597317	19.996168	

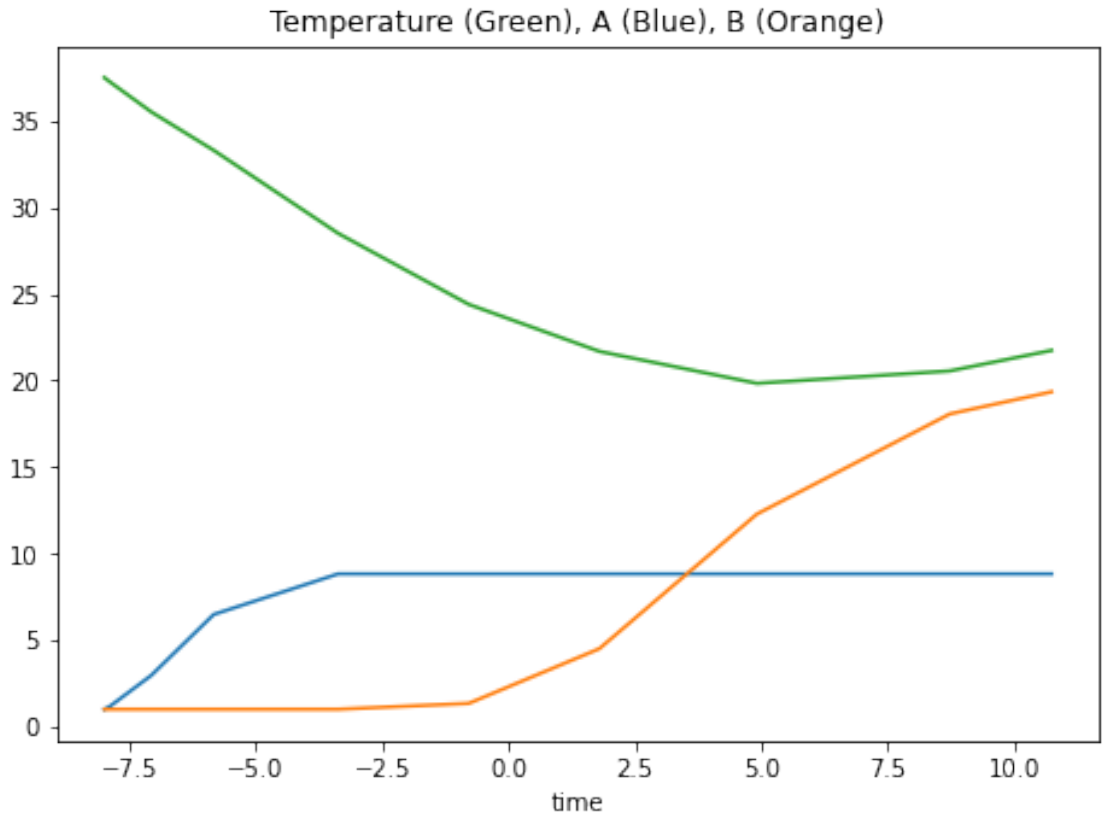
4	-20	4.578118	19.966083
5	-19	4.687205	19.741804
6	-18	5.748296	19.741332
7	-17	8.494992	19.887803
8	-16	9.614631	19.880514
9	-15	9.614631	19.709072
10	-14	9.614631	19.758933
11	-13	9.614631	19.749094
12	-12	9.631476	19.658082
13	-11	9.624722	19.621656
14	-10	9.532974	19.569831
15	-9	9.373612	19.451756
16	-8	8.822401	19.343464
17	-7	7.794229	19.080825
18	-6	6.272330	18.816201
19	-5	5.022834	18.432287
20	-4	4.602313	17.849296
21	-3	4.602313	16.549543
22	-2	4.602313	15.189577
23	-1	4.602313	12.895109

	T when found
0	21.041972
1	21.392161
2	21.351807
3	21.231813
4	21.279549
5	21.497693
6	21.372585
7	21.394274
8	21.289023
9	21.454614
10	21.377353
11	21.709645
12	21.408144
13	21.371504
14	21.628439
15	21.513396
16	21.736093
17	21.340081
18	21.320197
19	21.433727
20	21.673903
21	21.902643
22	22.095236
23	22.355396

[104]:
```
# Plot body temp, A, and B, and display the final state.

# === YOUR CODE HERE ===
y = dynamics(-8,timeFound)
fig = plt.figure()
ax=fig.add_axes([0,0,1,1])
ax.plot(y.t,y.y[0])
ax.plot(y.t,y.y[1])
ax.plot(y.t,y.y[2])
ax.set_title("Temperature (Green), A (Blue), B (Orange)")
ax.set_xlabel('time')
```

[104]:
```
Text(0.5, 0, 'time')
```



1.3 (c) Prime Suspect

Double-click to answer here.

[101]:
```
I think he was killed at approximately 4pm (16:00) on oct 6, which makes Dennis␣
↪Rillerson the prime suspect
```

```
  File "<ipython-input-101-80c624032130>", line 1
    I think he was killed at approximately 4pm on oct 6, which makes Dennis␣
↪Rillerson the prime suspect
             ^
SyntaxError: invalid syntax
```

[ ]: