Running Data

from \_\_future\_\_ import print\_function

import datetime

import numpy as np

from matplotlib import cm, pyplot as plt

from matplotlib.dates import YearLocator, MonthLocator

try:

from matplotlib.finance import quotes\_historical\_yahoo\_ochl

except ImportError:

# For Matplotlib prior to 1.5.

from matplotlib.finance import (

quotes\_historical\_yahoo as quotes\_historical\_yahoo\_ochl

)

from hmmlearn.hmm import GaussianHMM

print(\_\_doc\_\_)

*"Import data from excel"*

from xlrd import open\_workbook

book = open\_workbook(*'data.xlsx'*)

sheet = book.sheet\_by\_index(0)

time\_x = []

current\_y = []

for k in range(1,sheet.nrows):

time\_x.append(str(sheet.row\_values(k)[1-1]))

current\_y.append(str(sheet.row\_values(k)[2-1]))

time\_xx = map(float, time\_x)

current\_yy = map(float, current\_y)

x = np.asarray(time\_xx)

y = np.asarray(current\_yy)

X = np.reshape(y,(-1,1))

*"Run Gaussian HMM"*

print(*"fitting to HMM and decoding ..."*, end=*""*)

# Make an HMM instance and execute fit

model = GaussianHMM(n\_components=10, covariance\_type=*"full"*, n\_iter=1000).fit(X)

# Predict the optimal sequence of internal hidden state

hidden\_states = model.predict(X)

print(*"hidden\_states"*, len(hidden\_states), hidden\_states)

print(*"done"*)

*"Print All hidden state parameter"*

print(*"Transition matrix"*)

print(model.transmat\_)

print()

print(*"Means and vars of each hidden state"*)

for i in range(model.n\_components):

print(*"{0}th hidden state"*.format(i))

print(*"mean = "*, model.means\_[i])

print(*"var = "*, np.diag(model.covars\_[i]))

print()

*"Hidden state"*

result = []

test = hidden\_states[0]

for ind, i in enumerate(hidden\_states):

if i != test:

if len(result) == 0:

result.append([test,0,ind-1])

else:

start = result[-1][2]+1

result.append([test,start,ind-1])

test = i

print(result)

# for i in range(0,len(hidden\_states)):

# print(i, ",", hidden\_states[i])

*"Plot data and result"*

x\_plot = []

y\_plot = []

for i in result:

x\_plot.append(i[1])

x\_plot.append(i[2])

y\_plot.append(model.means\_[i[0]])

y\_plot.append(model.means\_[i[0]])

plt.figure(1)

plt.title(*"hmm Gaussian method fitting result vs data"*)

plt.plot(x,y, *'r'*)#, x,y, 'bo')

plt.plot(x\_plot, y\_plot, *'k'*)

plt.savefig(*"result10"*)

plt.show()

Result, n = 10, iter = 1000

hidden\_states 9937 [3 3 3 ... 6 6 6]

done

Transition matrix

[[4.55206055e-001 2.05650746e-002 1.71612222e-243 1.28177263e-001

7.20645805e-003 1.61912087e-002 1.41510235e-001 3.86590259e-002

8.48727370e-002 1.07611943e-001]

[1.35358880e-002 9.77379788e-001 0.00000000e+000 1.38483185e-038

9.08432387e-003 0.00000000e+000 0.00000000e+000 1.14527081e-138

0.00000000e+000 2.64420386e-027]

[3.68170931e-265 0.00000000e+000 9.90909091e-001 9.09090909e-003

0.00000000e+000 0.00000000e+000 0.00000000e+000 1.98185808e-123

0.00000000e+000 3.87644858e-305]

[1.00416192e-002 3.31787966e-122 4.98608677e-004 8.66452610e-001

2.24653483e-003 2.75429289e-003 4.15172137e-015 8.13968546e-002

2.42244918e-063 3.66094799e-002]

[1.41296717e-002 3.50870964e-003 0.00000000e+000 3.97550025e-003

9.73984670e-001 6.46594347e-165 3.89054213e-016 2.09877368e-026

4.40144801e-003 1.63583059e-015]

[3.15075645e-005 3.94452479e-243 0.00000000e+000 2.58022910e-003

9.56622483e-004 9.62352562e-001 9.19903194e-004 1.35912136e-050

2.70500004e-002 6.10917483e-003]

[1.25518437e-002 3.71860013e-005 0.00000000e+000 8.97288829e-039

9.70202127e-004 1.15892492e-059 9.39391333e-001 6.14687868e-065

4.30660143e-002 3.98342041e-003]

[7.85251914e-003 2.21198713e-151 4.90314923e-234 1.62218081e-001

2.35263958e-003 6.92126623e-056 8.27841852e-085 8.27576760e-001

1.60228864e-095 7.84729911e-033]

[1.35008183e-002 1.17931287e-003 0.00000000e+000 9.92917607e-025

1.56498665e-003 1.70930708e-002 6.51974610e-002 3.10286703e-004

8.97795024e-001 3.35903994e-003]

[1.87412037e-002 1.21439289e-067 4.62675586e-196 6.60435004e-002

1.93310635e-015 4.78763915e-003 8.64884754e-003 1.83061308e-007

3.49676227e-003 8.98281864e-001]]

Means and vars of each hidden state

0th hidden state

mean = [-5.37155017]

var = [0.01669278]

1th hidden state

mean = [-4.45951062]

var = [0.00293709]

2th hidden state

mean = [-3.36100879]

var = [0.00170159]

3th hidden state

mean = [-5.48935155]

var = [0.00046626]

4th hidden state

mean = [-4.98600292]

var = [0.01774987]

5th hidden state

mean = [-5.64500038]

var = [0.0011457]

6th hidden state

mean = [-5.56630195]

var = [0.00034131]

7th hidden state

mean = [-5.44506748]

var = [0.00105561]

8th hidden state

mean = [-5.59509013]

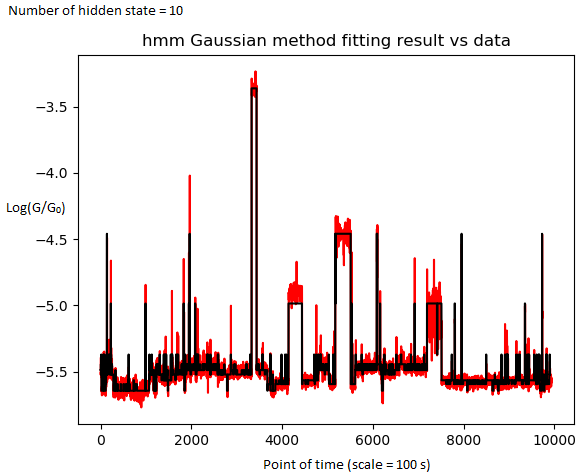
var = [0.00044852]

9th hidden state

mean = [-5.52266216]

var = [0.00051641]

[[3, 0, 5], [7, 6, 10], [3, 11, 11], [9, 12, 15], [0, 16, 16], [3, 17, 19], [5, 20, 62], [9, 63, 64], [0, 65, 68], [8, 69, 78], [0, 79, 79], [5, 80, 113], [8, 114, 123], [7, 124, 127], [3, 128, 129], [9, 130, 133], [0, 134, 135], [9, 136, 138], [0, 139, 140], [1, 141, 141], [0, 142, 142], [9, 143, 156], [3, 157, 157], [7, 158, 159], [3, 160, 164], [0, 165, 165], [3, 166, 174], [7, 175, 175], [3, 176, 180], [7, 181, 184], [3, 185, 190], [0, 191, 195], [9, 196, 209], [3, 210, 215], [7, 216, 216], [3, 217, 226], [4, 227, 227], [0, 228, 229], [9, 230, 232], [0, 233, 233], [9, 234, 240], [3, 241, 246], [7, 247, 252], [3, 253, 253], [9, 254, 282], [5, 283, 327], [3, 328, 328], [5, 329, 363], [8, 364, 381], [5, 382, 441], [8, 442, 453], [5, 454, 503], [8, 504, 517], [5, 518, 555], [8, 556, 566], [5, 567, 581], [8, 582, 593], [5, 594, 605], [8, 606, 611], [6, 612, 618], [0, 619, 619], [8, 620, 622], [5, 623, 627], [8, 628, 648], [5, 649, 724], [8, 725, 725], [6, 726, 737], [8, 738, 740], [5, 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7181, 7190], [7, 7191, 7194], [4, 7195, 7414], [0, 7415, 7426], [4, 7427, 7513], [0, 7514, 7515], [6, 7516, 7617], [8, 7618, 7625], [6, 7626, 7647], [8, 7648, 7650], [6, 7651, 7668], [8, 7669, 7678], [6, 7679, 7695], [8, 7696, 7710], [6, 7711, 7740], [0, 7741, 7741], [6, 7742, 7789], [8, 7790, 7794], [6, 7795, 7799], [8, 7800, 7804], [4, 7805, 7810], [8, 7811, 7816], [6, 7817, 7840], [8, 7841, 7843], [6, 7844, 7867], [8, 7868, 7874], [6, 7875, 7912], [8, 7913, 7955], [1, 7956, 7959], [0, 7960, 7960], [6, 7961, 7972], [8, 7973, 7993], [6, 7994, 8076], [8, 8077, 8081], [5, 8082, 8087], [8, 8088, 8097], [6, 8098, 8114], [8, 8115, 8135], [6, 8136, 8151], [8, 8152, 8174], [6, 8175, 8205], [8, 8206, 8220], [6, 8221, 8246], [8, 8247, 8251], [6, 8252, 8263], [8, 8264, 8268], [6, 8269, 8309], [8, 8310, 8320], [6, 8321, 8352], [8, 8353, 8397], [6, 8398, 8411], [8, 8412, 8432], [6, 8433, 8457], [8, 8458, 8499], [0, 8500, 8500], [6, 8501, 8633], [8, 8634, 8635], [5, 8636, 8657], [8, 8658, 8660], [6, 8661, 8689], [9, 8690, 8693], [8, 8694, 8696], [6, 8697, 8717], [8, 8718, 8727], [6, 8728, 8750], [8, 8751, 8752], [6, 8753, 8754], [8, 8755, 8757], [5, 8758, 8776], [8, 8777, 8782], [6, 8783, 8806], [8, 8807, 8824], [6, 8825, 8836], [0, 8837, 8837], [6, 8838, 8850], [8, 8851, 8857], [6, 8858, 8875], [8, 8876, 8879], [6, 8880, 8886], [8, 8887, 8896], [6, 8897, 8903], [8, 8904, 8908], [6, 8909, 8912], [0, 8913, 8913], [9, 8914, 8925], [6, 8926, 8940], [8, 8941, 8944], [0, 8945, 8957], [6, 8958, 8959], [0, 8960, 8961], [6, 8962, 8978], [0, 8979, 8979], [6, 8980, 8991], [8, 8992, 8996], [6, 8997, 9060], [8, 9061, 9065], [6, 9066, 9116], [8, 9117, 9131], [6, 9132, 9140], [8, 9141, 9144], [6, 9145, 9162], [0, 9163, 9163], [6, 9164, 9202], [0, 9203, 9203], [6, 9204, 9237], [0, 9238, 9238], [6, 9239, 9284], [8, 9285, 9295], [6, 9296, 9301], [8, 9302, 9316], [6, 9317, 9351], [4, 9352, 9356], [0, 9357, 9357], [6, 9358, 9371], [8, 9372, 9393], [6, 9394, 9402], [0, 9403, 9403], [6, 9404, 9426], [8, 9427, 9429], [0, 9430, 9430], [8, 9431, 9438], [6, 9439, 9442], [0, 9443, 9445], [6, 9446, 9555], [0, 9556, 9557], [6, 9558, 9599], [8, 9600, 9611], [0, 9612, 9613], [8, 9614, 9621], [6, 9622, 9626], [8, 9627, 9631], [6, 9632, 9654], [0, 9655, 9655], [6, 9656, 9668], [0, 9669, 9669], [6, 9670, 9673], [8, 9674, 9686], [5, 9687, 9725], [8, 9726, 9726], [0, 9727, 9727], [8, 9728, 9729], [0, 9730, 9730], [1, 9731, 9731], [0, 9732, 9735], [8, 9736, 9760], [9, 9761, 9763], [8, 9764, 9769], [5, 9770, 9782], [8, 9783, 9792], [9, 9793, 9796], [8, 9797, 9822], [0, 9823, 9823], [8, 9824, 9827], [0, 9828, 9830], [8, 9831, 9859], [6, 9860, 9876], [8, 9877, 9889], [9, 9890, 9898], [0, 9899, 9900], [9, 9901, 9906]]



Result, n = 5, iter = 1000

hidden\_states 9937 [1 1 1 ... 4 4 4]

done

Transition matrix

[[9.69253842e-001 1.00057054e-002 3.84099626e-073 1.07361401e-003

1.96668389e-002]

[3.15130246e-003 9.84211250e-001 2.41632726e-004 6.95460770e-003

5.44120705e-003]

[1.36447497e-075 9.09090909e-003 9.90909091e-001 5.71261204e-102

3.00239277e-070]

[4.73419866e-003 2.68508310e-002 5.05839118e-102 9.49427936e-001

1.89870345e-002]

[6.03454901e-003 6.38141622e-003 2.86943099e-065 7.64461882e-003

9.79939416e-001]]

Means and vars of each hidden state

0th hidden state

mean = [-5.63767913]

var = [0.00125644]

1th hidden state

mean = [-5.48621626]

var = [0.00147555]

2th hidden state

mean = [-3.36100879]

var = [0.00170159]

3th hidden state

mean = [-4.84388781]

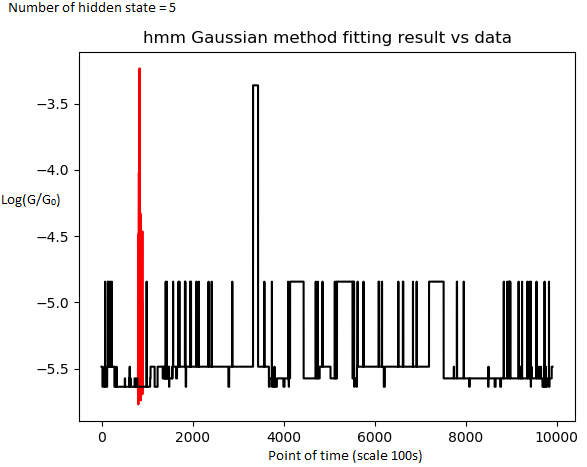
var = [0.09032678]

4th hidden state

mean = [-5.57454729]

var = [0.00055008]

[[1, 0, 19], [0, 20, 62], [1, 63, 68], [4, 69, 78], [3, 79, 79], [0, 80, 123], [1, 124, 138], [3, 139, 141], [1, 142, 164], [3, 165, 165], [1, 166, 190], [3, 191, 191], [1, 192, 226], [3, 227, 227], [1, 228, 282], [0, 283, 327], [1, 328, 328], [0, 329, 510], [4, 511, 517], [0, 518, 605], [4, 606, 618], [1, 619, 619], [0, 620, 627], [4, 628, 643], [0, 644, 725], [4, 726, 737], [0, 738, 768], [4, 769, 785], [0, 786, 990], [3, 991, 991], [1, 992, 992], [0, 993, 1067], [4, 1068, 1076], [1, 1077, 1166], [0, 1167, 1231], [1, 1232, 1343], [4, 1344, 1353], [1, 1354, 1363], [4, 1364, 1378], [1, 1379, 1382], [4, 1383, 1393], [1, 1394, 1394], [4, 1395, 1409], [3, 1410, 1410], [4, 1411, 1433], [3, 1434, 1435], [4, 1436, 1446], [1, 1447, 1447], [4, 1448, 1469], [1, 1470, 1482], [0, 1483, 1488], [4, 1489, 1546], [1, 1547, 1549], [4, 1550, 1561], [1, 1562, 1571], [3, 1572, 1572], [1, 1573, 1637], [4, 1638, 1658], [1, 1659, 1689], [3, 1690, 1692], [1, 1693, 1709], [3, 1710, 1710], [1, 1711, 1831], [3, 1832, 1833], [1, 1834, 1838], [3, 1839, 1840], [1, 1841, 1848], [0, 1849, 1858], [1, 1859, 1946], [3, 1947, 1948], [1, 1949, 1962], [3, 1963, 1966], [1, 1967, 2081], [3, 2082, 2089], [1, 2090, 2136], [3, 2137, 2137], [1, 2138, 2348], [3, 2349, 2351], [1, 2352, 2419], [3, 2420, 2420], [1, 2421, 2786], [0, 2787, 2803], [1, 2804, 2871], [3, 2872, 2872], [1, 2873, 3328], [2, 3329, 3438], [1, 3439, 3576], [3, 3577, 3577], [1, 3578, 3676], [0, 3677, 3693], [4, 3694, 3742], [3, 3743, 3743], [0, 3744, 3796], [1, 3797, 3799], [0, 3800, 3851], [4, 3852, 3994], [0, 3995, 4019], [4, 4020, 4097], [3, 4098, 4098], [4, 4099, 4113], [0, 4114, 4116], [4, 4117, 4142], [3, 4143, 4439], [4, 4440, 4705], [3, 4706, 4706], [4, 4707, 4753], [3, 4754, 4754], [4, 4755, 4792], [1, 4793, 4853], [3, 4854, 4854], [1, 4855, 5030], [4, 5031, 5124], [3, 5125, 5125], [4, 5126, 5153], [3, 5154, 5154], [4, 5155, 5172], [3, 5173, 5513], [4, 5514, 5528], [3, 5529, 5535], [4, 5536, 5546], [3, 5547, 5547], [4, 5548, 5551], [0, 5552, 5558], [4, 5559, 5604], [0, 5605, 5611], [1, 5612, 5623], [3, 5624, 5626], [1, 5627, 5754], [3, 5755, 5755], [1, 5756, 6084], [3, 6085, 6100], [1, 6101, 6160], [3, 6161, 6162], [1, 6163, 6200], [0, 6201, 6224], [1, 6225, 6519], [3, 6520, 6520], [1, 6521, 6619], [3, 6620, 6630], [1, 6631, 6841], [3, 6842, 6842], [1, 6843, 6922], [3, 6923, 6923], [1, 6924, 7194], [3, 7195, 7515], [4, 7516, 7739], [1, 7740, 7741], [4, 7742, 7804], [3, 7805, 7810], [4, 7811, 7955], [3, 7956, 7960], [4, 7961, 8076], [0, 8077, 8087], [4, 8088, 8492], [0, 8493, 8499], [1, 8500, 8500], [4, 8501, 8635], [0, 8636, 8657], [4, 8658, 8757], [0, 8758, 8776], [4, 8777, 8836], [3, 8837, 8837], [4, 8838, 8912], [3, 8913, 8913], [1, 8914, 8925], [4, 8926, 8944], [3, 8945, 8957], [1, 8958, 8960], [3, 8961, 8961], [4, 8962, 8978], [3, 8979, 8979], [4, 8980, 9162], [3, 9163, 9163], [4, 9164, 9202], [1, 9203, 9203], [4, 9204, 9237], [3, 9238, 9238], [4, 9239, 9351], [3, 9352, 9357], [4, 9358, 9402], [3, 9403, 9403], [4, 9404, 9429], [3, 9430, 9430], [0, 9431, 9434], [4, 9435, 9442], [1, 9443, 9445], [4, 9446, 9555], [3, 9556, 9556], [4, 9557, 9611], [1, 9612, 9613], [4, 9614, 9654], [1, 9655, 9655], [4, 9656, 9686], [0, 9687, 9726], [1, 9727, 9727], [0, 9728, 9729], [1, 9730, 9730], [3, 9731, 9735], [4, 9736, 9744], [0, 9745, 9760], [1, 9761, 9763], [0, 9764, 9786], [4, 9787, 9829], [3, 9830, 9830], [0, 9831, 9840], [4, 9841, 9889], [1, 9890, 9906]]



Result, n = 15, iter = 1000

hidden\_states 9937 [13 13 13 ... 8 8 8]

done

Transition matrix

[[2.47915445e-001 1.93663530e-038 1.22159928e-002 0.00000000e+000

2.23122454e-002 2.41303527e-078 6.37097835e-055 2.33142298e-001

1.17383466e-001 1.55563266e-001 3.14206799e-002 0.00000000e+000

8.59102667e-008 2.72201709e-002 1.52826350e-001]

[1.97684194e-149 9.83447859e-001 0.00000000e+000 0.00000000e+000

0.00000000e+000 1.83540350e-090 2.01135978e-003 1.96706038e-283

0.00000000e+000 0.00000000e+000 1.45407811e-002 0.00000000e+000

1.70890447e-243 3.69186802e-135 0.00000000e+000]

[6.39406005e-037 0.00000000e+000 9.33624109e-001 0.00000000e+000

5.95393360e-002 8.87032552e-292 7.06688008e-204 6.83655495e-003

1.38514133e-101 6.60650646e-051 1.05165694e-071 0.00000000e+000

4.30712510e-104 1.12721710e-035 9.22242090e-065]

[0.00000000e+000 0.00000000e+000 0.00000000e+000 9.90909091e-001

0.00000000e+000 0.00000000e+000 0.00000000e+000 0.00000000e+000

0.00000000e+000 0.00000000e+000 0.00000000e+000 0.00000000e+000

8.83661094e-072 9.09090909e-003 0.00000000e+000]

[1.36957315e-003 4.46199297e-191 1.05040055e-002 0.00000000e+000

9.08262203e-001 5.68482508e-083 4.04296237e-108 6.41038788e-003

1.79660816e-008 2.63096430e-003 1.47913024e-003 0.00000000e+000

5.98337864e-014 2.88424748e-007 6.93434292e-002]

[8.75038730e-018 2.79140970e-194 0.00000000e+000 0.00000000e+000

6.44377656e-125 9.61378202e-001 2.83786180e-085 1.62136916e-054

6.21652961e-003 5.79874738e-003 7.59643006e-003 1.57255511e-002

9.27133959e-043 4.48034745e-054 3.28453979e-003]

[2.12890542e-064 1.52285966e-121 4.10729048e-233 0.00000000e+000

3.85586954e-099 1.53408815e-076 7.62444893e-001 8.12054225e-054

9.24946417e-150 8.02833581e-171 6.83707265e-005 0.00000000e+000

2.17099120e-001 2.03876159e-002 1.79799474e-119]

[5.13711065e-002 1.07120079e-155 1.09975063e-115 0.00000000e+000

4.23554684e-003 3.96729265e-087 1.73327570e-043 8.55535212e-001

2.31789313e-014 7.27065387e-005 1.11306147e-008 0.00000000e+000

2.18877153e-002 6.68976365e-002 6.49646664e-008]

[6.89521451e-003 1.02061774e-046 2.01835271e-097 0.00000000e+000

2.12216753e-026 1.95548811e-003 9.16274812e-145 4.83071155e-015

8.95525085e-001 5.39865871e-002 1.12506640e-003 0.00000000e+000

8.30979355e-061 6.20289943e-097 4.05125585e-002]

[2.73688764e-002 2.81583385e-146 2.19148163e-226 0.00000000e+000

2.11392090e-053 1.55802652e-016 6.36822903e-173 1.53761545e-007

7.49906903e-002 8.95172323e-001 2.21516075e-004 0.00000000e+000

2.41133893e-054 7.23104050e-078 2.24644020e-003]

[7.05519069e-002 6.50613886e-002 7.15075700e-114 0.00000000e+000

3.20528806e-031 3.81192875e-002 1.40243736e-006 3.84597461e-002

1.26692372e-002 1.71052163e-002 4.55364647e-001 0.00000000e+000

9.26482763e-002 1.83565105e-001 2.64537864e-002]

[0.00000000e+000 0.00000000e+000 0.00000000e+000 0.00000000e+000

0.00000000e+000 1.76412556e-002 0.00000000e+000 0.00000000e+000

0.00000000e+000 0.00000000e+000 9.61826866e-239 9.82358744e-001

0.00000000e+000 0.00000000e+000 8.10090349e-228]

[1.39565127e-037 2.59545706e-162 5.89125071e-066 1.18309808e-290

2.35659509e-003 5.49586413e-043 5.28503054e-002 3.31135258e-019

4.75434305e-004 1.23781633e-026 7.21242610e-003 0.00000000e+000

8.07734932e-001 1.29370307e-001 2.51080105e-066]

[2.10346837e-016 3.53378185e-259 3.87638440e-096 7.40497262e-004

2.03173955e-011 1.73936795e-005 1.94621671e-003 5.07664091e-002

2.82178627e-053 1.09209487e-035 9.37916791e-003 0.00000000e+000

1.48892100e-001 7.88258215e-001 2.30435388e-086]

[2.88337735e-002 1.03073237e-003 1.58516827e-003 0.00000000e+000

4.63943649e-002 1.98356183e-003 1.16504920e-087 9.18508671e-016

6.23838005e-002 2.13122457e-003 4.53226091e-016 0.00000000e+000

2.13330119e-003 3.00474620e-029 8.53524073e-001]]

Means and vars of each hidden state

0th hidden state

mean = [-5.46878821]

var = [0.0078824]

1th hidden state

mean = [-4.45698236]

var = [0.00253427]

2th hidden state

mean = [-5.69273852]

var = [0.00077967]

3th hidden state

mean = [-3.36100879]

var = [0.00170159]

4th hidden state

mean = [-5.64079326]

var = [0.00054563]

5th hidden state

mean = [-5.1033274]

var = [0.01093581]

6th hidden state

mean = [-5.41693492]

var = [0.0014816]

7th hidden state

mean = [-5.52803083]

var = [0.00047904]

8th hidden state

mean = [-5.57798594]

var = [0.00028907]

9th hidden state

mean = [-5.55879719]

var = [0.00033149]

10th hidden state

mean = [-5.00799253]

var = [0.11056685]

11th hidden state

mean = [-4.89606694]

var = [0.00068208]

12th hidden state

mean = [-5.46900982]

var = [0.00059069]

13th hidden state

mean = [-5.50225882]

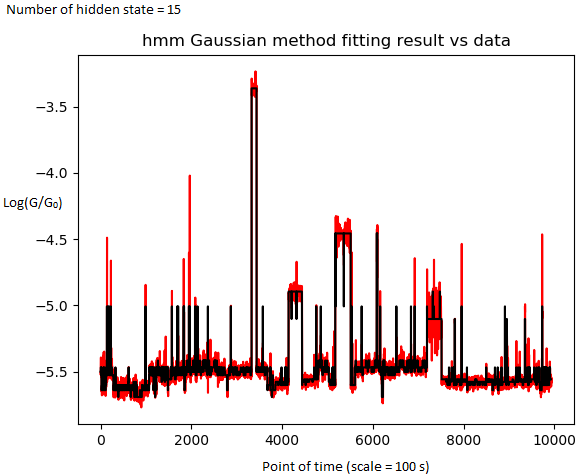
var = [0.00028073]

14th hidden state

mean = [-5.60236862]

var = [0.00047571]

[[13, 0, 5], [12, 6, 10], [13, 11, 11], [7, 12, 15], [12, 16, 19], [4, 20, 29], [14, 30, 38], [4, 39, 43], [14, 44, 57], [4, 58, 62], [7, 63, 64], [0, 65, 68], [14, 69, 78], [0, 79, 79], [4, 80, 87], [14, 88, 98], [4, 99, 113], [14, 114, 123], [12, 124, 127], [13, 128, 129], [7, 130, 133], [0, 134, 135], [7, 136, 138], [0, 139, 140], [10, 141, 141], [7, 142, 156], [12, 157, 157], [6, 158, 159], [12, 160, 161], [13, 162, 164], [10, 165, 165], [13, 166, 168], [12, 169, 169], [13, 170, 173], [12, 174, 174], [6, 175, 175], [12, 176, 190], [10, 191, 191], [0, 192, 195], [7, 196, 209], [13, 210, 210], [12, 211, 218], [13, 219, 224], [12, 225, 226], [10, 227, 227], [0, 228, 229], [7, 230, 232], [0, 233, 233], [7, 234, 235], [13, 236, 246], [12, 247, 253], [13, 254, 255], [7, 256, 282], [4, 283, 292], [14, 293, 300], [4, 301, 327], [0, 328, 328], [4, 329, 346], [14, 347, 350], [4, 351, 363], [14, 364, 381], [4, 382, 389], [2, 390, 393], [4, 394, 410], [14, 411, 414], [4, 415, 426], [14, 427, 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Result, n = 5, iter = 1000

hidden\_states 9937 [3 3 3 ... 0 0 0]

done

Transition matrix

[[9.79939416e-001 7.64461882e-003 2.86943098e-065 6.38141622e-003

6.03454901e-003]

[1.89870346e-002 9.49427936e-001 5.05839119e-102 2.68508310e-002

4.73419867e-003]

[3.00239277e-070 5.71261205e-102 9.90909091e-001 9.09090909e-003

1.36447495e-075]

[5.44120705e-003 6.95460770e-003 2.41632726e-004 9.84211250e-001

3.15130246e-003]

[1.96668389e-002 1.07361401e-003 3.84099619e-073 1.00057054e-002

9.69253842e-001]]

Means and vars of each hidden state

0th hidden state

mean = [-5.57454729]

var = [0.00055008]

1th hidden state

mean = [-4.84388781]

var = [0.09032678]

2th hidden state

mean = [-3.36100879]

var = [0.00170159]

3th hidden state

mean = [-5.48621626]

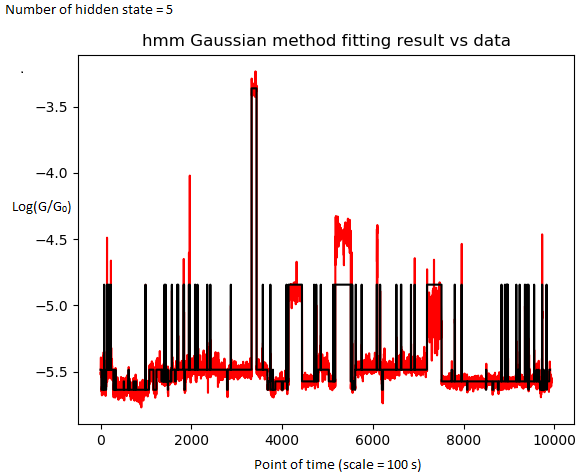
var = [0.00147555]

4th hidden state

mean = [-5.63767913]

var = [0.00125644]

[[3, 0, 19], [4, 20, 62], [3, 63, 68], [0, 69, 78], [1, 79, 79], [4, 80, 123], [3, 124, 138], [1, 139, 141], [3, 142, 164], [1, 165, 165], [3, 166, 190], [1, 191, 191], [3, 192, 226], [1, 227, 227], [3, 228, 282], [4, 283, 327], [3, 328, 328], [4, 329, 510], [0, 511, 517], [4, 518, 605], [0, 606, 618], [3, 619, 619], [4, 620, 627], [0, 628, 643], [4, 644, 725], [0, 726, 737], [4, 738, 768], [0, 769, 785], [4, 786, 990], [1, 991, 991], [3, 992, 992], [4, 993, 1067], [0, 1068, 1076], [3, 1077, 1166], [4, 1167, 1231], [3, 1232, 1343], [0, 1344, 1353], [3, 1354, 1363], [0, 1364, 1378], [3, 1379, 1382], [0, 1383, 1393], [3, 1394, 1394], [0, 1395, 1409], [1, 1410, 1410], [0, 1411, 1433], [1, 1434, 1435], [0, 1436, 1446], [3, 1447, 1447], [0, 1448, 1469], [3, 1470, 1482], [4, 1483, 1488], [0, 1489, 1546], [3, 1547, 1549], [0, 1550, 1561], [3, 1562, 1571], [1, 1572, 1572], [3, 1573, 1637], [0, 1638, 1658], [3, 1659, 1689], [1, 1690, 1692], [3, 1693, 1709], [1, 1710, 1710], [3, 1711, 1831], [1, 1832, 1833], [3, 1834, 1838], [1, 1839, 1840], [3, 1841, 1848], [4, 1849, 1858], [3, 1859, 1946], [1, 1947, 1948], [3, 1949, 1962], [1, 1963, 1966], [3, 1967, 2081], [1, 2082, 2089], [3, 2090, 2136], [1, 2137, 2137], [3, 2138, 2348], [1, 2349, 2351], [3, 2352, 2419], [1, 2420, 2420], [3, 2421, 2786], [4, 2787, 2803], [3, 2804, 2871], [1, 2872, 2872], [3, 2873, 3328], [2, 3329, 3438], [3, 3439, 3576], [1, 3577, 3577], [3, 3578, 3676], [4, 3677, 3693], [0, 3694, 3742], [1, 3743, 3743], [4, 3744, 3796], [3, 3797, 3799], [4, 3800, 3851], [0, 3852, 3994], [4, 3995, 4019], [0, 4020, 4097], [1, 4098, 4098], [0, 4099, 4113], [4, 4114, 4116], [0, 4117, 4142], [1, 4143, 4439], [0, 4440, 4705], [1, 4706, 4706], [0, 4707, 4753], [1, 4754, 4754], [0, 4755, 4792], [3, 4793, 4853], [1, 4854, 4854], [3, 4855, 5030], [0, 5031, 5124], [1, 5125, 5125], [0, 5126, 5153], [1, 5154, 5154], [0, 5155, 5172], [1, 5173, 5513], [0, 5514, 5528], [1, 5529, 5535], [0, 5536, 5546], [1, 5547, 5547], [0, 5548, 5551], [4, 5552, 5558], [0, 5559, 5604], [4, 5605, 5611], [3, 5612, 5623], [1, 5624, 5626], [3, 5627, 5754], [1, 5755, 5755], [3, 5756, 6084], [1, 6085, 6100], [3, 6101, 6160], [1, 6161, 6162], [3, 6163, 6200], [4, 6201, 6224], [3, 6225, 6519], [1, 6520, 6520], [3, 6521, 6619], [1, 6620, 6630], [3, 6631, 6841], [1, 6842, 6842], [3, 6843, 6922], [1, 6923, 6923], [3, 6924, 7194], [1, 7195, 7515], [0, 7516, 7739], [3, 7740, 7741], [0, 7742, 7804], [1, 7805, 7810], [0, 7811, 7955], [1, 7956, 7960], [0, 7961, 8076], [4, 8077, 8087], [0, 8088, 8492], [4, 8493, 8499], [3, 8500, 8500], [0, 8501, 8635], [4, 8636, 8657], [0, 8658, 8757], [4, 8758, 8776], [0, 8777, 8836], [1, 8837, 8837], [0, 8838, 8912], [1, 8913, 8913], [3, 8914, 8925], [0, 8926, 8944], [1, 8945, 8957], [3, 8958, 8960], [1, 8961, 8961], [0, 8962, 8978], [1, 8979, 8979], [0, 8980, 9162], [1, 9163, 9163], [0, 9164, 9202], [3, 9203, 9203], [0, 9204, 9237], [1, 9238, 9238], [0, 9239, 9351], [1, 9352, 9357], [0, 9358, 9402], [1, 9403, 9403], [0, 9404, 9429], [1, 9430, 9430], [4, 9431, 9434], [0, 9435, 9442], [3, 9443, 9445], [0, 9446, 9555], [1, 9556, 9556], [0, 9557, 9611], [3, 9612, 9613], [0, 9614, 9654], [3, 9655, 9655], [0, 9656, 9686], [4, 9687, 9726], [3, 9727, 9727], [4, 9728, 9729], [3, 9730, 9730], [1, 9731, 9735], [0, 9736, 9744], [4, 9745, 9760], [3, 9761, 9763], [4, 9764, 9786], [0, 9787, 9829], [1, 9830, 9830], [4, 9831, 9840], [0, 9841, 9889], [3, 9890, 9906]]



New Running Data

*"To call functions, tools from Library"*

from \_\_future\_\_ import print\_function

import datetime

import numpy as np

from matplotlib import cm, pyplot as plt

from matplotlib.dates import YearLocator, MonthLocator

try:

from matplotlib.finance import quotes\_historical\_yahoo\_ochl

except ImportError:

# For Matplotlib prior to 1.5.

from matplotlib.finance import (

quotes\_historical\_yahoo as quotes\_historical\_yahoo\_ochl

)

from hmmlearn.hmm import GaussianHMM

# print(\_\_doc\_\_)

*"Import data from excel file"*

from xlrd import open\_workbook

book = open\_workbook(*'Data2.xlsx'*)

sheet = book.sheet\_by\_index(0)

x = []

y = []

for k in range(1,sheet.nrows):

x.append(str(sheet.row\_values(k)[1-1]))

y.append(str(sheet.row\_values(k)[2-1]))

x = np.asarray(map(float, x))

y = np.asarray(map(float, y))

X = np.reshape(y,(-1,1))

*"Run Gaussian HMM"*

# Make an HMM instance and execute fit

n\_comp = 5

model = GaussianHMM(n\_components=n\_comp, covariance\_type=*"full"*, n\_iter=1000).fit(X)

# Predict the optimal sequence of internal hidden state

hidden\_states = model.predict(X)

print(*"done fitting to HMM"*)

*"Print All hidden state parameter"*

print(*"Transition matrix"*)

print(model.transmat\_)

print()

print(*"Means and Variance of each hidden state"*)

for i in range(model.n\_components):

print(*"{0}th hidden state"*.format(i))

print(*"mean = "*, model.means\_[i])

print(*"variance = "*, np.diag(model.covars\_[i]))

print()

*"Hidden state"*

result = []

test = hidden\_states[0]

for ind, i in enumerate(hidden\_states):

if n\_comp == 1 and ind == 0:

result.append([0,0,test])

if i != test:

if len(result) == 0:

result.append([0,ind-1,test])

else:

result.append([result[-1][1]+1,ind-1,test])

test = i

for i in range(0,len(result)):

result[i][0] = x[result[i][0]]

result[i][1] = x[result[i][1]]

result[i][2] = model.means\_[result[i][2]][0]

*"Print RESULT"*

print(*"Record of all hidden state"*)

print(*"\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*"*)

print(*"No."*,*" "*,*"TIME Start"*,*" - "*,*"TIME End"*,*" "*,*"VALUE"*)

for i in range(0,len(result)):

print(i, *" "*,result[i][0], *" - "*, result[i][1], *" "*, result[i][2])

*"Plot data and result"*

x\_plot = []

y\_plot = []

for i in result:

x\_plot.append(i[0])

x\_plot.append(i[1])

y\_plot.append(i[2])

y\_plot.append(i[2])

plt.figure(1)

plt.title(*"hmm Gaussian method fitting result vs data"*)

plt.plot(x,y, *'r'*)#, x,y, 'bo')

plt.plot(x\_plot, y\_plot, *'k'*)

plt.savefig(*"resultData2n5new"*)

plt.show()

n component = 5, n iter = 1000

done fitting to HMM

Transition matrix

[[9.69253842e-001 1.07361401e-003 3.84099618e-073 1.00057054e-002

1.96668389e-002]

[4.73419866e-003 9.49427936e-001 5.05839119e-102 2.68508310e-002

1.89870345e-002]

[1.36447495e-075 5.71261206e-102 9.90909091e-001 9.09090909e-003

3.00239279e-070]

[3.15130246e-003 6.95460770e-003 2.41632726e-004 9.84211250e-001

5.44120705e-003]

[6.03454901e-003 7.64461882e-003 2.86943100e-065 6.38141622e-003

9.79939416e-001]]

Means and Variance of each hidden state

0th hidden state

mean = [-5.63767913]

variance = [0.00125644]

1th hidden state

mean = [-4.84388781]

variance = [0.09032678]

2th hidden state

mean = [-3.36100879]

variance = [0.00170159]

3th hidden state

mean = [-5.48621626]

variance = [0.00147555]

4th hidden state

mean = [-5.57454729]

variance = [0.00055008]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 800.02031 - 800.21033 -5.48621625872

1 800.22033 - 800.64033 -5.63767913021

2 800.65033 - 800.70036 -5.48621625872

3 800.71033 - 800.83037 -5.57454728509

4 800.8746 - 800.8746 -4.84388781343

5 800.89957 - 801.33037 -5.63767913021

6 801.34035 - 801.48037 -5.48621625872

7 801.49032 - 801.51032 -4.84388781343

8 801.52037 - 801.77033 -5.48621625872

9 801.78031 - 801.78031 -4.84388781343

10 801.79037 - 802.06032 -5.48621625872

11 802.07036 - 802.07036 -4.84388781343

12 802.08037 - 802.42031 -5.48621625872

13 802.46327 - 802.46327 -4.84388781343

14 802.47033 - 803.01031 -5.48621625872

15 803.02031 - 803.49038 -5.63767913021

16 803.50038 - 803.50038 -5.48621625872

17 803.51038 - 805.32037 -5.63767913021

18 805.33033 - 805.39037 -5.57454728509

19 805.40037 - 806.30032 -5.63767913021

20 806.31037 - 806.43032 -5.57454728509

21 806.44117 - 806.44117 -5.48621625872

22 806.45037 - 806.52033 -5.63767913021

23 806.53036 - 806.68037 -5.57454728509

24 806.69118 - 807.50037 -5.63767913021

25 807.5106 - 807.62033 -5.57454728509

26 807.63036 - 807.93033 -5.63767913021

27 807.94031 - 808.10036 -5.57454728509

28 808.11037 - 810.15032 -5.63767913021

29 810.16033 - 810.16033 -4.84388781343

30 810.17033 - 810.17033 -5.48621625872

31 810.18037 - 810.96037 -5.63767913021

32 810.97033 - 811.05033 -5.57454728509

33 811.06033 - 811.95033 -5.48621625872

34 811.96033 - 812.60037 -5.63767913021

35 812.61037 - 813.72052 -5.48621625872

36 813.73037 - 813.82036 -5.57454728509

37 813.83037 - 813.92036 -5.48621625872

38 813.93033 - 814.07033 -5.57454728509

39 814.08032 - 814.11033 -5.48621625872

40 814.12031 - 814.22036 -5.57454728509

41 814.23033 - 814.23033 -5.48621625872

42 814.24036 - 814.38036 -5.57454728509

43 814.39038 - 814.39038 -4.84388781343

44 814.40036 - 814.62036 -5.57454728509

45 814.63033 - 814.64036 -4.84388781343

46 814.65033 - 814.75033 -5.57454728509

47 814.76037 - 814.76037 -5.48621625872

48 814.77033 - 814.98032 -5.57454728509

49 814.99033 - 815.11033 -5.48621625872

50 815.12032 - 815.17037 -5.63767913021

51 815.18032 - 815.75031 -5.57454728509

52 815.76031 - 815.78031 -5.48621625872

53 815.79037 - 815.90033 -5.57454728509

54 815.91036 - 816.00037 -5.48621625872

55 816.01032 - 816.01032 -4.84388781343

56 816.02032 - 816.66101 -5.48621625872

57 816.67032 - 816.87032 -5.57454728509

58 816.88032 - 817.18032 -5.48621625872

59 817.19032 - 817.21032 -4.84388781343

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62 817.40033 - 818.60033 -5.48621625872

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64 818.63032 - 818.67036 -5.48621625872

65 818.68033 - 818.69119 -4.84388781343

66 818.70037 - 818.77036 -5.48621625872

67 818.78037 - 818.87036 -5.63767913021

68 818.88033 - 819.79032 -5.48621625872

69 819.80151 - 819.81037 -4.84388781343

70 819.82037 - 819.95032 -5.48621625872

71 819.96032 - 820.03001 -4.84388781343

72 820.04033 - 821.18031 -5.48621625872

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74 821.27032 - 821.73033 -5.48621625872

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76 821.75037 - 823.85033 -5.48621625872

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164 889.78037 - 889.89032 -5.48621625872

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184 894.99048 - 895.06037 -5.57454728509

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186 895.10032 - 896.19037 -5.57454728509

187 896.20032 - 896.20032 -4.84388781343

188 896.21037 - 896.75032 -5.57454728509

189 896.76037 - 896.77032 -5.48621625872

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191 897.19045 - 897.19045 -5.48621625872

192 897.20032 - 897.50031 -5.57454728509

193 897.51033 - 897.90036 -5.63767913021

194 897.91037 - 897.91037 -5.48621625872

195 897.92032 - 897.93032 -5.63767913021

196 897.94039 - 897.94039 -5.48621625872

197 897.95037 - 897.99032 -4.84388781343

198 898.00033 - 898.08037 -5.57454728509

199 898.09037 - 898.24037 -5.63767913021

200 898.25032 - 898.27036 -5.48621625872

201 898.28033 - 898.50037 -5.63767913021

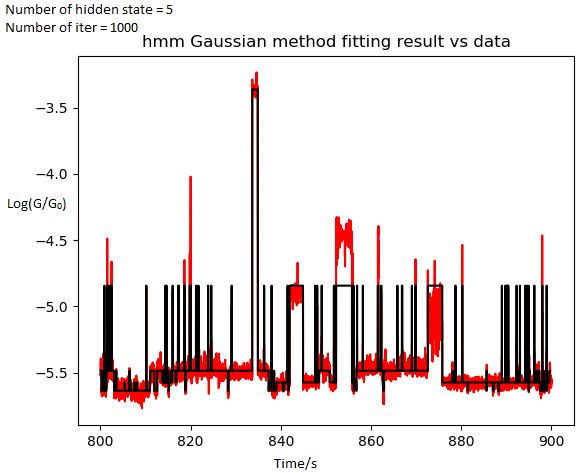
202 898.51036 - 898.93032 -5.57454728509

203 898.94043 - 898.94043 -4.84388781343

204 898.95032 - 899.04037 -5.63767913021

205 899.05037 - 899.53037 -5.57454728509

206 899.54037 - 899.70032 -5.48621625872



n component = 10, n iter = 1000

done fitting to HMM

Transition matrix

[[8.97694317e-001 1.14818034e-003 0.00000000e+000 1.56314423e-003

3.36395200e-003 3.10939790e-004 1.71163618e-002 6.53019145e-002

1.45294397e-024 1.35011908e-002]

[0.00000000e+000 9.77381162e-001 0.00000000e+000 9.07929314e-003

8.47180681e-027 2.51299675e-138 0.00000000e+000 0.00000000e+000

2.40425335e-038 1.35395453e-002]

[0.00000000e+000 0.00000000e+000 9.90909091e-001 0.00000000e+000

2.33444278e-302 8.62664334e-123 0.00000000e+000 0.00000000e+000

9.09090909e-003 1.90860552e-263]

[4.40137477e-003 3.48891049e-003 0.00000000e+000 9.74005132e-001

1.55109129e-015 3.08159772e-026 1.86905054e-164 4.88955132e-016

3.97521059e-003 1.41293726e-002]

[3.50689293e-003 6.60570443e-067 4.70904921e-194 1.31750725e-015

8.98222299e-001 2.33905220e-007 4.78646948e-003 8.65690390e-003

6.60740531e-002 1.87531473e-002]

[4.11508615e-095 7.73967830e-150 2.38017616e-232 2.35365719e-003

1.32508503e-032 8.27612973e-001 1.55205400e-055 2.29626339e-084

1.62174950e-001 7.85841995e-003]

[2.70790140e-002 2.51338271e-241 0.00000000e+000 9.56883543e-004

6.10836603e-003 2.79589304e-050 9.62323204e-001 9.19642885e-004

2.58212546e-003 3.07637930e-005]

[4.30768200e-002 6.47584232e-005 0.00000000e+000 9.65627291e-004

3.98381593e-003 1.84057833e-064 3.26450540e-059 9.39360164e-001

1.62740077e-038 1.25488148e-002]

[5.47008757e-063 2.20048432e-121 4.98747934e-004 2.24523801e-003

3.66155732e-002 8.15040088e-002 2.75631321e-003 4.48685899e-015

8.66337628e-001 1.00424913e-002]

[8.48170789e-002 2.05491179e-002 2.42719440e-242 7.20560636e-003

1.07603297e-001 3.87047228e-002 1.61793132e-002 1.41471717e-001

1.28139246e-001 4.55329900e-001]]

Means and Variance of each hidden state

0th hidden state

mean = [-5.59510599]

variance = [0.00044845]

1th hidden state

mean = [-4.45951835]

variance = [0.00293939]

2th hidden state

mean = [-3.36100879]

variance = [0.00170159]

3th hidden state

mean = [-4.98601329]

variance = [0.01774515]

4th hidden state

mean = [-5.52267676]

variance = [0.00051637]

5th hidden state

mean = [-5.44509915]

variance = [0.00105534]

6th hidden state

mean = [-5.64500971]

variance = [0.00114556]

7th hidden state

mean = [-5.56630695]

variance = [0.00034127]

8th hidden state

mean = [-5.48937225]

variance = [0.00046593]

9th hidden state

mean = [-5.371557]

variance = [0.01668811]

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Record of all hidden state

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597 887.25037 - 887.53032 -5.56630694843

598 887.54037 - 887.57032 -5.52267675808

599 887.58037 - 887.60037 -5.59510599329

600 887.61032 - 887.81037 -5.56630694843

601 887.82037 - 887.91032 -5.59510599329

602 887.92032 - 888.14032 -5.56630694843

603 888.15032 - 888.16037 -5.59510599329

604 888.17032 - 888.18037 -5.56630694843

605 888.19037 - 888.21032 -5.59510599329

606 888.22037 - 888.40032 -5.64500971206

607 888.41145 - 888.46037 -5.59510599329

608 888.47036 - 888.70036 -5.56630694843

609 888.71032 - 888.88032 -5.59510599329

610 888.89032 - 889.00036 -5.56630694843

611 889.01037 - 889.01037 -5.37155699568

612 889.02086 - 889.14032 -5.56630694843

613 889.15032 - 889.21032 -5.59510599329

614 889.22037 - 889.39032 -5.56630694843

615 889.40036 - 889.43032 -5.59510599329

616 889.44032 - 889.50037 -5.56630694843

617 889.51037 - 889.60032 -5.59510599329

618 889.61037 - 889.67037 -5.56630694843

619 889.68032 - 889.72036 -5.59510599329

620 889.73037 - 889.76032 -5.56630694843

621 889.77037 - 889.77037 -5.37155699568

622 889.78037 - 889.89032 -5.52267675808

623 889.90032 - 890.04032 -5.56630694843

624 890.05032 - 890.08037 -5.59510599329

625 890.09037 - 890.21037 -5.37155699568

626 890.22032 - 890.23037 -5.56630694843

627 890.24037 - 890.25032 -5.37155699568

628 890.26033 - 890.42032 -5.56630694843

629 890.43037 - 890.43037 -5.37155699568

630 890.44032 - 890.55037 -5.56630694843

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632 890.61037 - 891.24032 -5.56630694843

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634 891.30037 - 891.80031 -5.56630694843

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636 891.96032 - 892.04037 -5.56630694843

637 892.0511 - 892.08051 -5.59510599329

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639 892.27037 - 892.27037 -5.37155699568

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641 892.67037 - 892.67037 -5.37155699568

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643 893.02032 - 893.02032 -5.37155699568

644 893.03037 - 893.48032 -5.56630694843

645 893.49037 - 893.59037 -5.59510599329

646 893.60037 - 893.65032 -5.56630694843

647 893.66037 - 893.80113 -5.59510599329

648 893.81037 - 894.15033 -5.56630694843

649 894.16037 - 894.20032 -4.98601329318

650 894.21033 - 894.21033 -5.37155699568

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652 894.36031 - 894.57036 -5.59510599329

653 894.58033 - 894.66141 -5.56630694843

654 894.67031 - 894.67031 -5.37155699568

655 894.68033 - 894.90032 -5.56630694843

656 894.91137 - 894.93033 -5.59510599329

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660 895.07033 - 895.09037 -5.37155699568

661 895.10032 - 896.19037 -5.56630694843

662 896.20032 - 896.21037 -5.37155699568

663 896.22037 - 896.63032 -5.56630694843

664 896.64032 - 896.75032 -5.59510599329

665 896.76037 - 896.77032 -5.37155699568

666 896.78036 - 896.85032 -5.59510599329

667 896.86037 - 896.90033 -5.56630694843

668 896.91032 - 896.95037 -5.59510599329

669 896.96033 - 897.18037 -5.56630694843

670 897.19045 - 897.19045 -5.37155699568

671 897.20032 - 897.32037 -5.56630694843

672 897.33032 - 897.33032 -5.37155699568

673 897.34037 - 897.37032 -5.56630694843

674 897.38037 - 897.50031 -5.59510599329

675 897.51033 - 897.89033 -5.64500971206

676 897.90036 - 897.90036 -5.59510599329

677 897.91037 - 897.91037 -5.37155699568

678 897.92032 - 897.93032 -5.59510599329

679 897.94039 - 897.94039 -5.37155699568

680 897.95037 - 897.95037 -4.45951835353

681 897.96037 - 897.99032 -5.37155699568

682 898.00033 - 898.24037 -5.59510599329

683 898.25032 - 898.27036 -5.52267675808

684 898.28033 - 898.33036 -5.59510599329

685 898.34037 - 898.46038 -5.64500971206

686 898.47036 - 898.56037 -5.59510599329

687 898.5706 - 898.60033 -5.52267675808

688 898.61032 - 898.86037 -5.59510599329

689 898.87032 - 898.87032 -5.37155699568

690 898.88042 - 898.91138 -5.59510599329

691 898.92032 - 898.94043 -5.37155699568

692 898.95032 - 899.23037 -5.59510599329

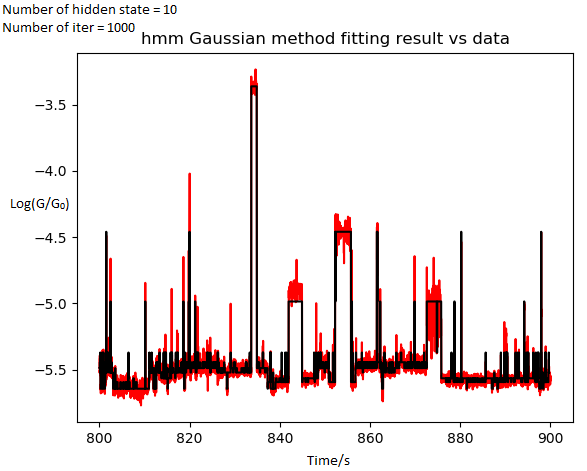
693 899.24037 - 899.40037 -5.56630694843

694 899.41142 - 899.53037 -5.59510599329

695 899.54037 - 899.62036 -5.52267675808

696 899.63036 - 899.64036 -5.37155699568

697 899.65083 - 899.70032 -5.52267675808



Temperature Variation (77K)

n component = 5, n iter = 1000

done fitting to HMM

Transition matrix

[[9.23631682e-01 1.70625637e-37 2.04174454e-02 4.72986943e-02

8.65217863e-03]

[1.15048276e-03 9.88608494e-01 6.16983927e-03 1.48971293e-03

2.58147057e-03]

[1.63925355e-02 1.42681489e-03 8.74731794e-01 7.90133025e-02

2.84355536e-02]

[2.03734283e-02 1.09011664e-03 5.00282004e-02 9.23758416e-01

4.74983884e-03]

[6.74519443e-03 4.94910748e-03 4.11410901e-02 1.42980720e-02

9.32866536e-01]]

Means and Variance of each hidden state

0th hidden state

mean = [-6.38213862]

variance = [0.00985336]

1th hidden state

mean = [-3.98549589]

variance = [0.03646276]

2th hidden state

mean = [-6.06157638]

variance = [0.01193632]

3th hidden state

mean = [-6.23459077]

variance = [0.00657786]

4th hidden state

mean = [-5.60727261]

variance = [0.05195241]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 100.02037 - 100.26033 -6.06157638146

1 100.27032 - 100.27032 -5.60727260783

2 100.28037 - 100.36033 -6.06157638146

3 100.37032 - 100.43032 -5.60727260783

4 100.44033 - 100.49036 -6.06157638146

5 100.50037 - 100.53055 -6.23459076714

6 100.54037 - 101.04037 -6.06157638146

7 101.05037 - 101.29033 -6.23459076714

8 101.30036 - 101.48057 -6.06157638146

9 101.49032 - 101.59033 -6.23459076714

10 101.60032 - 101.65037 -6.06157638146

11 101.66036 - 101.77032 -6.23459076714

12 101.78036 - 101.85037 -6.06157638146

13 101.86032 - 101.99037 -6.23459076714

14 102.00037 - 102.0613 -6.06157638146

15 102.07032 - 102.19037 -6.23459076714

16 102.20174 - 102.75032 -6.38213861802

17 102.76037 - 103.0613 -6.23459076714

18 103.07036 - 103.08032 -6.06157638146

19 103.09039 - 103.11036 -5.60727260783

20 103.12032 - 103.13032 -6.06157638146

21 103.14032 - 103.33036 -6.23459076714

22 103.34037 - 103.42037 -6.06157638146

23 103.43036 - 103.66036 -6.23459076714

24 103.67105 - 103.81131 -6.38213861802

25 103.82036 - 104.00036 -6.23459076714

26 104.01037 - 104.28032 -6.06157638146

27 104.29037 - 104.63037 -6.23459076714

28 104.64032 - 104.83033 -6.38213861802

29 104.8404 - 104.87032 -6.23459076714

30 104.88031 - 104.98037 -6.06157638146

31 104.99037 - 105.00037 -5.60727260783

32 105.01037 - 105.15032 -6.23459076714

33 105.16032 - 105.24032 -6.06157638146

34 105.25033 - 105.27037 -6.23459076714

35 105.28036 - 105.32032 -6.38213861802

36 105.33037 - 105.38037 -6.06157638146

37 105.39037 - 105.56038 -5.60727260783

38 105.57038 - 105.63037 -6.38213861802

39 105.64081 - 105.72038 -6.06157638146

40 105.73051 - 106.09047 -6.23459076714

41 106.10038 - 106.11033 -6.06157638146

42 106.12038 - 106.20038 -6.38213861802

43 106.21038 - 106.37033 -6.23459076714

44 106.38033 - 106.39033 -6.06157638146

45 106.40033 - 106.49033 -6.23459076714

46 106.50038 - 106.51038 -6.06157638146

47 106.52038 - 106.59033 -6.23459076714

48 106.60033 - 106.69038 -6.06157638146

49 106.70038 - 106.89033 -6.38213861802

50 106.90035 - 106.93036 -5.60727260783

51 106.94033 - 106.98033 -6.06157638146

52 106.99038 - 107.00033 -5.60727260783

53 107.01038 - 107.11033 -6.06157638146

54 107.12033 - 107.21038 -5.60727260783

55 107.22033 - 107.28038 -6.06157638146

56 107.29033 - 107.32038 -6.38213861802

57 107.33033 - 108.07037 -5.60727260783

58 108.08058 - 108.50037 -6.06157638146

59 108.51033 - 108.54032 -5.60727260783

60 108.55038 - 108.68037 -6.06157638146

61 108.69038 - 108.70175 -5.60727260783

62 108.71038 - 108.89038 -6.06157638146

63 108.90037 - 108.96032 -5.60727260783

64 108.97038 - 109.22032 -6.06157638146

65 109.23059 - 109.96037 -5.60727260783

66 109.97033 - 110.15032 -6.06157638146

67 110.16038 - 110.19037 -6.23459076714

68 110.20178 - 110.30037 -6.06157638146

69 110.31124 - 110.44037 -6.23459076714

70 110.45179 - 110.55037 -6.06157638146

71 110.56037 - 110.57037 -6.23459076714

72 110.58032 - 110.5904 -6.06157638146

73 110.60032 - 110.66032 -6.23459076714

74 110.67038 - 110.78032 -6.38213861802

75 110.79038 - 110.82032 -6.06157638146

76 110.83037 - 110.84047 -5.60727260783

77 110.85038 - 110.88037 -6.06157638146

78 110.89033 - 110.96032 -5.60727260783

79 110.97038 - 111.00037 -6.06157638146

80 111.01033 - 111.07033 -6.23459076714

81 111.08032 - 111.14032 -6.38213861802

82 111.15033 - 111.22032 -6.23459076714

83 111.23033 - 111.56037 -6.38213861802

84 111.57038 - 111.62032 -6.06157638146

85 111.63033 - 111.73038 -6.23459076714

86 111.74032 - 111.78032 -6.06157638146

87 111.79033 - 111.84043 -6.38213861802

88 111.85033 - 111.89033 -6.23459076714

89 111.90035 - 111.90035 -6.06157638146

90 111.91032 - 111.94033 -5.60727260783

91 111.95174 - 112.07037 -6.23459076714

92 112.08037 - 112.15038 -6.06157638146

93 112.16036 - 112.29037 -6.38213861802

94 112.30032 - 112.46032 -6.23459076714

95 112.47038 - 112.60032 -6.06157638146

96 112.61033 - 112.64032 -6.38213861802

97 112.65033 - 112.65033 -5.60727260783

98 112.66037 - 112.66037 -6.06157638146

99 112.67086 - 112.82036 -6.38213861802

100 112.83033 - 112.87033 -6.06157638146

101 112.88032 - 112.93036 -6.38213861802

102 112.94038 - 113.08033 -6.23459076714

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104 113.13037 - 113.17032 -6.23459076714

105 113.18033 - 113.53037 -6.38213861802

106 113.54033 - 113.59039 -6.23459076714

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108 113.65037 - 113.90033 -6.38213861802

109 113.91032 - 113.95175 -6.23459076714

110 113.96033 - 114.0613 -6.38213861802

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114 114.26038 - 114.47033 -6.23459076714

115 114.48054 - 114.49033 -5.60727260783

116 114.50037 - 114.53033 -6.06157638146

117 114.54036 - 114.68031 -5.60727260783

118 114.6907 - 115.68036 -6.06157638146

119 115.69033 - 115.81033 -5.60727260783

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123 116.11036 - 116.21032 -6.23459076714

124 116.22032 - 116.25037 -6.06157638146

125 116.26037 - 116.44032 -6.23459076714

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135 119.04526 - 119.26037 -6.23459076714

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137 119.30219 - 119.31185 -3.98549588686

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139 119.49037 - 119.56125 -6.23459076714

140 119.60467 - 119.61069 -3.98549588686

141 119.63753 - 119.98032 -6.06157638146

142 120.01762 - 124.0007 -3.98549588686

143 124.02755 - 124.02755 -6.06157638146

144 124.04037 - 124.07038 -6.23459076714

145 124.08033 - 124.15033 -6.06157638146

146 124.16033 - 124.16033 -5.60727260783

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152 124.53033 - 124.80037 -6.23459076714

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154 125.07373 - 128.59069 -3.98549588686

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178 130.87036 - 130.89032 -5.60727260783

179 130.90037 - 131.18037 -6.23459076714

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276 148.20177 - 148.21037 -6.06157638146

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281 150.32036 - 150.40037 -6.06157638146

282 150.41037 - 150.66032 -6.23459076714

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285 150.70175 - 150.81032 -6.38213861802

286 150.82036 - 150.85032 -6.06157638146

287 150.86036 - 150.93032 -6.23459076714

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289 150.95032 - 151.55032 -6.23459076714

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308 158.71037 - 158.77032 -6.06157638146

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490 186.68037 - 186.74037 -5.60727260783

491 186.75037 - 186.95032 -6.23459076714

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493 187.02032 - 187.20032 -6.23459076714

494 187.21032 - 187.28037 -6.06157638146

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500 188.00032 - 188.12037 -6.38213861802

501 188.13037 - 188.34041 -6.23459076714

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535 193.45114 - 193.49037 -6.23459076714

536 193.50033 - 193.53037 -6.06157638146

537 193.54037 - 193.68032 -6.23459076714

538 193.69036 - 193.83033 -6.06157638146

539 193.84032 - 194.55036 -6.23459076714

540 194.56142 - 194.59041 -6.06157638146

541 194.60037 - 194.60037 -5.60727260783

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548 196.87032 - 196.95181 -6.23459076714

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554 197.68031 - 198.24032 -6.23459076714

555 198.25037 - 198.42084 -6.38213861802

556 198.43037 - 198.48032 -6.06157638146

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559 198.85036 - 198.89032 -6.23459076714

560 198.90032 - 198.97037 -6.06157638146

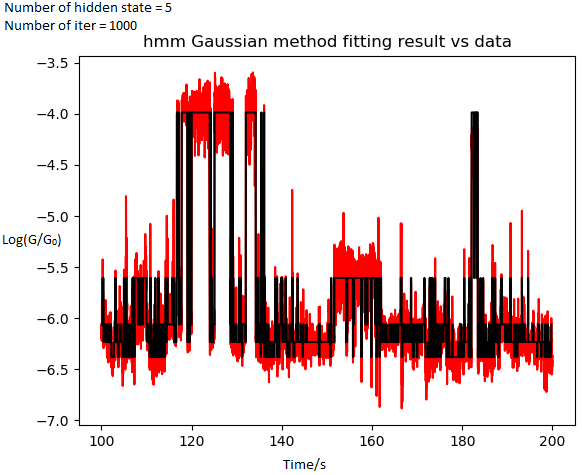
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563 199.58032 - 199.65037 -6.38213861802

564 199.66037 - 199.74032 -6.23459076714

565 199.7506 - 199.76037 -6.06157638146



n component = 3, n iter = 1000

Current 2

done fitting to HMM

Transition matrix

[[9.84258974e-01 9.52471955e-04 1.47885545e-02]

[6.38811011e-03 9.88946812e-01 4.66507797e-03]

[5.08590317e-02 3.70692946e-03 9.45434039e-01]]

Means and Variance of each hidden state

0th hidden state

mean = [-6.23154044]

variance = [0.01820434]

1th hidden state

mean = [-3.98523656]

variance = [0.03632792]

2th hidden state

mean = [-5.70412243]

variance = [0.0686542]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 100.02037 - 100.15036 -6.23154043723

1 100.16032 - 100.44033 -5.70412242908

2 100.45036 - 100.53055 -6.23154043723

3 100.54037 - 100.62033 -5.70412242908

4 100.63032 - 100.89032 -6.23154043723

5 100.90037 - 100.99032 -5.70412242908

6 101.00033 - 103.08032 -6.23154043723

7 103.09039 - 103.11036 -5.70412242908

8 103.12032 - 104.02032 -6.23154043723

9 104.03032 - 104.05033 -5.70412242908

10 104.06129 - 104.98037 -6.23154043723

11 104.99037 - 105.00037 -5.70412242908

12 105.01037 - 105.38037 -6.23154043723

13 105.39037 - 105.56038 -5.70412242908

14 105.57038 - 105.64081 -6.23154043723

15 105.65033 - 105.70038 -5.70412242908

16 105.71038 - 106.89033 -6.23154043723

17 106.90035 - 107.27033 -5.70412242908

18 107.28038 - 107.32038 -6.23154043723

19 107.33033 - 108.12038 -5.70412242908

20 108.13037 - 108.19037 -6.23154043723

21 108.20033 - 108.54032 -5.70412242908

22 108.55038 - 108.63038 -6.23154043723

23 108.64032 - 109.00037 -5.70412242908

24 109.01033 - 109.22032 -6.23154043723

25 109.23059 - 109.96037 -5.70412242908

26 109.97033 - 110.82032 -6.23154043723

27 110.83037 - 110.96032 -5.70412242908

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32 112.66037 - 113.08033 -6.23154043723

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34 113.12033 - 114.22033 -6.23154043723

35 114.23037 - 114.25032 -5.70412242908

36 114.26038 - 114.47033 -6.23154043723

37 114.48054 - 115.03031 -5.70412242908

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39 115.12033 - 115.17032 -5.70412242908

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43 115.61038 - 115.82032 -5.70412242908

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93 134.91033 - 134.92037 -5.70412242908

94 134.93038 - 135.46038 -6.23154043723

95 135.47038 - 135.47038 -3.98523655546

96 135.48056 - 135.61038 -6.23154043723

97 135.62033 - 135.65035 -5.70412242908

98 135.66037 - 135.78462 -6.23154043723

99 135.80523 - 135.8404 -5.70412242908

100 135.85033 - 136.02032 -6.23154043723

101 136.05207 - 136.06185 -3.98523655546

102 136.09535 - 136.13037 -6.23154043723

103 136.14037 - 136.14037 -5.70412242908

104 136.15033 - 138.50037 -6.23154043723

105 138.51037 - 138.51037 -5.70412242908

106 138.52037 - 138.91037 -6.23154043723

107 138.92037 - 138.94037 -5.70412242908

108 138.95037 - 139.65032 -6.23154043723

109 139.66033 - 140.11032 -5.70412242908

110 140.12037 - 140.73037 -6.23154043723

111 140.74033 - 140.92037 -5.70412242908

112 140.93037 - 142.26037 -6.23154043723

113 142.27036 - 142.46036 -5.70412242908

114 142.47032 - 143.48037 -6.23154043723

115 143.49037 - 143.51032 -5.70412242908

116 143.52032 - 150.31131 -6.23154043723

117 150.32036 - 150.40037 -5.70412242908

118 150.41037 - 150.93032 -6.23154043723

119 150.94036 - 150.94036 -5.70412242908

120 150.95032 - 151.56032 -6.23154043723

121 151.57036 - 151.57036 -5.70412242908

122 151.58032 - 151.61032 -6.23154043723

123 151.62032 - 154.26033 -5.70412242908

124 154.27037 - 154.30033 -6.23154043723

125 154.3113 - 154.32037 -5.70412242908

126 154.33032 - 154.49037 -6.23154043723

127 154.50032 - 155.75033 -5.70412242908

128 155.76032 - 155.78032 -6.23154043723

129 155.79037 - 157.62033 -5.70412242908

130 157.63038 - 157.70037 -6.23154043723

131 157.71033 - 159.80037 -5.70412242908

132 159.81037 - 159.87036 -6.23154043723

133 159.88036 - 160.95037 -5.70412242908

134 160.96032 - 161.09048 -6.23154043723

135 161.10037 - 161.58032 -5.70412242908

136 161.59048 - 161.63037 -6.23154043723

137 161.64047 - 162.01037 -5.70412242908

138 162.02037 - 166.32037 -6.23154043723

139 166.33033 - 166.55032 -5.70412242908

140 166.56032 - 166.74037 -6.23154043723

141 166.75037 - 166.77037 -5.70412242908

142 166.78032 - 167.72032 -6.23154043723

143 167.73051 - 167.75037 -5.70412242908

144 167.76032 - 168.60037 -6.23154043723

145 168.61033 - 168.71031 -5.70412242908

146 168.72037 - 171.38033 -6.23154043723

147 171.39032 - 171.64032 -5.70412242908

148 171.65036 - 172.78033 -6.23154043723

149 172.79033 - 172.79033 -5.70412242908

150 172.80045 - 172.93033 -6.23154043723

151 172.94033 - 173.05033 -5.70412242908

152 173.06033 - 173.14033 -6.23154043723

153 173.15037 - 173.25033 -5.70412242908

154 173.26033 - 173.94037 -6.23154043723

155 173.95037 - 174.02033 -5.70412242908

156 174.03037 - 175.91033 -6.23154043723

157 175.92033 - 176.34043 -5.70412242908

158 176.35033 - 176.91032 -6.23154043723

159 176.92037 - 176.93032 -5.70412242908

160 176.94032 - 180.43032 -6.23154043723

161 180.44037 - 180.44037 -5.70412242908

162 180.45115 - 181.57062 -6.23154043723

163 181.58036 - 181.58036 -5.70412242908

164 181.59037 - 182.04037 -6.23154043723

165 182.05037 - 182.05037 -5.70412242908

166 182.0946 - 182.60065 -3.98523655546

167 182.62589 - 182.72033 -5.70412242908

168 182.7647 - 183.22324 -3.98523655546

169 183.24527 - 183.28033 -5.70412242908

170 183.29037 - 183.42112 -3.98523655546

171 183.4469 - 184.62032 -6.23154043723

172 184.63037 - 184.64031 -5.70412242908

173 184.65032 - 186.67033 -6.23154043723

174 186.68037 - 186.74037 -5.70412242908

175 186.75037 - 187.28037 -6.23154043723

176 187.29032 - 187.30037 -5.70412242908

177 187.31032 - 188.4208 -6.23154043723

178 188.43037 - 188.53061 -5.70412242908

179 188.54032 - 188.67036 -6.23154043723

180 188.68033 - 188.70109 -5.70412242908

181 188.71032 - 188.89032 -6.23154043723

182 188.90037 - 189.02037 -5.70412242908

183 189.03032 - 189.47032 -6.23154043723

184 189.48057 - 189.50033 -5.70412242908

185 189.51036 - 190.66044 -6.23154043723

186 190.67033 - 190.73038 -5.70412242908

187 190.74037 - 191.48033 -6.23154043723

188 191.49037 - 191.52037 -5.70412242908

189 191.53033 - 193.22037 -6.23154043723

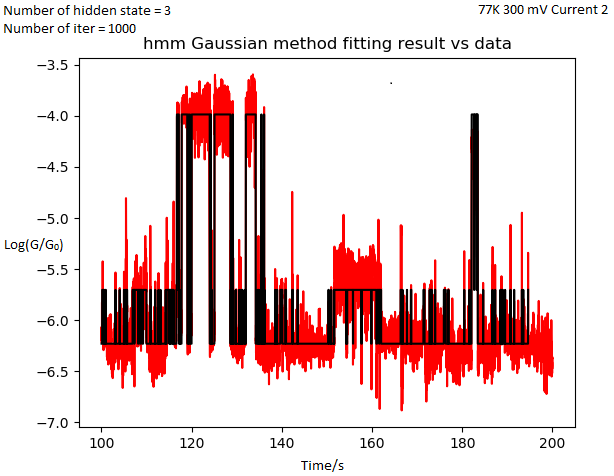
190 193.23033 - 193.23033 -5.70412242908

191 193.24033 - 193.50033 -6.23154043723

192 193.51037 - 193.53037 -5.70412242908

193 193.54037 - 194.59041 -6.23154043723

194 194.60037 - 194.60037 -5.70412242908



n component = 2, n iter = 1000

Current 12

done fitting to HMM

Transition matrix

[[0.99198401 0.00801599]

[0.04110234 0.95889766]]

Means and Variance of each hidden state

0th hidden state

mean = [-6.18205162]

variance = [0.00948708]

1th hidden state

mean = [-5.51393428]

variance = [0.00940223]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 240.02031 - 241.30037 -6.18205161707

1 241.31056 - 241.32037 -5.51393427519

2 241.33037 - 241.35037 -6.18205161707

3 241.36037 - 241.37033 -5.51393427519

4 241.38037 - 242.64037 -6.18205161707

5 242.65037 - 242.65037 -5.51393427519

6 242.66032 - 247.91037 -6.18205161707

7 247.92041 - 247.94032 -5.51393427519

8 247.95031 - 247.95031 -6.18205161707

9 247.96032 - 247.99032 -5.51393427519

10 248.00037 - 249.45033 -6.18205161707

11 249.46033 - 249.47037 -5.51393427519

12 249.48033 - 253.28036 -6.18205161707

13 253.29031 - 254.19032 -5.51393427519

14 254.20033 - 254.29032 -6.18205161707

15 254.30056 - 255.75036 -5.51393427519

16 255.76037 - 255.77032 -6.18205161707

17 255.78033 - 256.79036 -5.51393427519

18 256.80033 - 256.85032 -6.18205161707

19 256.86033 - 256.99032 -5.51393427519

20 257.00099 - 257.02037 -6.18205161707

21 257.03032 - 257.93032 -5.51393427519

22 257.94037 - 257.95036 -6.18205161707

23 257.96037 - 257.98037 -5.51393427519

24 257.99037 - 260.24032 -6.18205161707

25 260.25032 - 260.32032 -5.51393427519

26 260.33032 - 260.39032 -6.18205161707

27 260.40037 - 260.40037 -5.51393427519

28 260.41037 - 265.78036 -6.18205161707

29 265.79036 - 265.80032 -5.51393427519

30 265.81032 - 265.83037 -6.18205161707

31 265.84031 - 265.88032 -5.51393427519

32 265.89037 - 267.58032 -6.18205161707

33 267.59032 - 267.60037 -5.51393427519

34 267.61032 - 267.88032 -6.18205161707

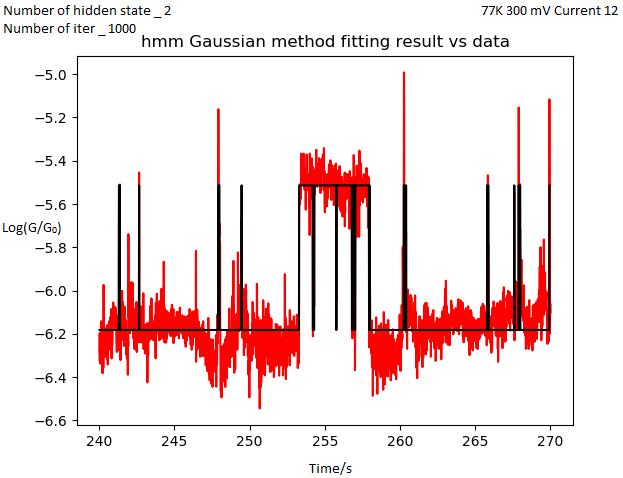
35 267.89032 - 267.90037 -5.51393427519

36 267.91037 - 267.92042 -6.18205161707

37 267.93037 - 267.99032 -5.51393427519

38 268.00072 - 269.92042 -6.18205161707

39 269.93031 - 269.94032 -5.51393427519



n component = 5, n iter = 1000

90K 300 mV Current 8

done fitting to HMM

Transition matrix

[[9.43022995e-001 4.92182811e-004 7.96578906e-163 2.40284187e-002

3.24564032e-002]

[1.67207625e-007 9.78862923e-001 6.31014396e-047 1.97763333e-002

1.36057678e-003]

[0.00000000e+000 3.37861866e-003 9.96621381e-001 0.00000000e+000

0.00000000e+000]

[6.62826217e-002 1.60196016e-002 6.98251383e-004 9.11000714e-001

5.99881181e-003]

[3.62976712e-002 5.19367660e-004 4.73654082e-229 3.54309176e-003

9.59639869e-001]]

Means and Variance of each hidden state

0th hidden state

mean = [-6.39413376]

variance = [0.00404005]

1th hidden state

mean = [-4.87883712]

variance = [0.09427548]

2th hidden state

mean = [-4.11191427]

variance = [0.00883348]

3th hidden state

mean = [-6.23494117]

variance = [0.01686094]

4th hidden state

mean = [-6.51682873]

variance = [0.00666724]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 0.05037 - 0.05037 -6.23494117411

1 0.06037 - 0.72037 -6.39413376117

2 0.73032 - 0.76037 -6.23494117411

3 0.77037 - 1.06033 -6.39413376117

4 1.07037 - 1.13037 -6.23494117411

5 1.14037 - 1.30037 -6.39413376117

6 1.31033 - 1.55109 -6.51682873432

7 1.56037 - 1.68037 -6.39413376117

8 1.69037 - 2.02037 -6.51682873432

9 2.03037 - 2.29033 -6.39413376117

10 2.30037 - 2.54033 -6.51682873432

11 2.55107 - 2.59031 -6.39413376117

12 2.60037 - 2.77037 -6.51682873432

13 2.78037 - 3.12041 -6.39413376117

14 3.13037 - 4.45036 -6.23494117411

15 4.46037 - 4.54033 -6.39413376117

16 4.55032 - 4.63082 -6.23494117411

17 4.64036 - 4.68037 -6.39413376117

18 4.69037 - 4.95032 -6.23494117411

19 4.96033 - 5.09037 -6.39413376117

20 5.10037 - 5.98032 -6.23494117411

21 5.99037 - 5.99037 -4.87883712155

22 6.00036 - 6.43037 -6.23494117411

23 6.44037 - 6.49032 -6.39413376117

24 6.50037 - 7.10033 -6.23494117411

25 7.11032 - 7.27032 -6.39413376117

26 7.28032 - 7.77042 -6.23494117411

27 7.78032 - 8.03038 -6.39413376117

28 8.04037 - 8.08036 -6.23494117411

29 8.09032 - 8.70033 -6.39413376117

30 8.71032 - 8.87031 -6.23494117411

31 8.88032 - 9.10032 -6.39413376117

32 9.11037 - 9.17033 -6.23494117411

33 9.18037 - 9.37033 -6.39413376117

34 9.38036 - 9.41033 -6.23494117411

35 9.42036 - 9.63041 -6.39413376117

36 9.64031 - 10.40033 -6.23494117411

37 10.41037 - 10.51036 -6.39413376117

38 10.52033 - 10.85033 -6.23494117411

39 10.86037 - 10.87032 -4.87883712155

40 10.88037 - 11.66032 -6.23494117411

41 11.67037 - 12.11036 -6.39413376117

42 12.12032 - 12.12032 -6.23494117411

43 12.13037 - 12.36037 -6.39413376117

44 12.37032 - 12.52036 -6.23494117411

45 12.53032 - 14.02037 -6.39413376117

46 14.03036 - 14.08041 -6.51682873432

47 14.09032 - 14.17032 -6.39413376117

48 14.18037 - 14.29037 -6.51682873432

49 14.30037 - 14.51037 -6.39413376117

50 14.52037 - 14.57033 -6.51682873432

51 14.58032 - 14.64036 -6.23494117411

52 14.65078 - 14.67033 -4.87883712155

53 14.68036 - 14.82037 -6.23494117411

54 14.83033 - 14.86032 -6.39413376117

55 14.87037 - 15.51032 -6.51682873432

56 15.52032 - 16.08032 -6.39413376117

57 16.09037 - 16.14036 -6.51682873432

58 16.15037 - 16.30037 -6.39413376117

59 16.31037 - 16.36036 -6.51682873432

60 16.37033 - 16.69037 -6.39413376117

61 16.70037 - 16.79033 -6.23494117411

62 16.80106 - 17.74032 -6.39413376117

63 17.75033 - 17.76037 -4.87883712155

64 17.77033 - 17.77033 -6.23494117411

65 17.78032 - 17.89033 -4.87883712155

66 17.90032 - 17.92032 -6.23494117411

67 17.93033 - 17.94037 -4.87883712155

68 17.95037 - 18.12038 -6.23494117411

69 18.13037 - 18.33032 -6.39413376117

70 18.34037 - 18.51037 -6.23494117411

71 18.52032 - 18.65033 -6.39413376117

72 18.66052 - 18.72032 -6.23494117411

73 18.73038 - 19.08032 -6.39413376117

74 19.09033 - 19.67032 -6.23494117411

75 19.68036 - 19.88077 -6.39413376117

76 19.89033 - 20.07036 -6.23494117411

77 20.08037 - 20.20037 -6.39413376117

78 20.21037 - 20.28033 -6.51682873432

79 20.29032 - 20.29032 -4.87883712155

80 20.30111 - 20.30111 -6.23494117411

81 20.31036 - 20.38033 -6.51682873432

82 20.39036 - 20.48033 -6.23494117411

83 20.49036 - 20.54037 -6.39413376117

84 20.55032 - 20.60033 -6.23494117411

85 20.61036 - 20.69169 -6.39413376117

86 20.70033 - 20.94168 -6.51682873432

87 20.95031 - 21.27033 -6.39413376117

88 21.28032 - 21.34036 -6.51682873432

89 21.35037 - 21.50037 -6.39413376117

90 21.51036 - 21.56032 -6.23494117411

91 21.57037 - 22.10045 -6.39413376117

92 22.11037 - 22.17036 -6.23494117411

93 22.18032 - 22.28036 -6.39413376117

94 22.29032 - 22.31037 -6.51682873432

95 22.32032 - 22.76033 -6.39413376117

96 22.77032 - 22.8304 -6.23494117411

97 22.84037 - 23.15036 -6.39413376117

98 23.16053 - 23.17033 -6.23494117411

99 23.18032 - 23.26032 -6.39413376117

100 23.27037 - 23.29033 -6.23494117411

101 23.30036 - 23.38032 -6.39413376117

102 23.39032 - 23.78037 -6.23494117411

103 23.79037 - 24.36032 -6.39413376117

104 24.37032 - 24.40032 -6.51682873432

105 24.41032 - 25.27037 -6.39413376117

106 25.28032 - 25.36032 -6.51682873432

107 25.37044 - 25.52037 -6.39413376117

108 25.53036 - 25.67032 -6.51682873432

109 25.68037 - 25.99032 -6.39413376117

110 26.00032 - 26.45033 -6.51682873432

111 26.46032 - 26.64037 -6.39413376117

112 26.65037 - 26.69168 -6.23494117411

113 26.70036 - 26.74032 -6.39413376117

114 26.75037 - 26.80114 -6.51682873432

115 26.81033 - 27.72033 -6.39413376117

116 27.73032 - 27.73032 -6.23494117411

117 27.74037 - 27.85036 -6.39413376117

118 27.86032 - 27.95032 -6.51682873432

119 27.96038 - 28.12037 -6.39413376117

120 28.13058 - 28.47032 -6.51682873432

121 28.48037 - 28.67032 -6.39413376117

122 28.68032 - 29.29036 -6.51682873432

123 29.30037 - 29.42033 -6.39413376117

124 29.43032 - 29.90037 -6.51682873432

125 29.91037 - 30.21033 -6.39413376117

126 30.22032 - 30.96032 -6.51682873432

127 30.97046 - 32.01037 -6.39413376117

128 32.02032 - 32.09033 -6.51682873432

129 32.10036 - 32.39032 -6.39413376117

130 32.40037 - 32.46037 -6.51682873432

131 32.47033 - 34.05036 -6.39413376117

132 34.06032 - 34.26037 -6.51682873432

133 34.27032 - 34.82032 -6.39413376117

134 34.83037 - 34.95032 -6.51682873432

135 34.96032 - 35.97032 -6.39413376117

136 35.98032 - 36.01032 -6.23494117411

137 36.02032 - 36.47032 -6.39413376117

138 36.48032 - 36.75032 -6.51682873432

139 36.76031 - 36.91054 -6.39413376117

140 36.92032 - 36.97032 -6.51682873432

141 36.98037 - 37.6606 -6.39413376117

142 37.67036 - 38.32037 -6.51682873432

143 38.33039 - 38.79037 -6.39413376117

144 38.80037 - 38.91059 -6.51682873432

145 38.92037 - 39.01032 -6.39413376117

146 39.02032 - 39.10037 -6.51682873432

147 39.11037 - 39.29032 -6.39413376117

148 39.30113 - 39.44169 -6.51682873432

149 39.45037 - 39.57037 -6.39413376117

150 39.5804 - 39.97032 -6.51682873432

151 39.98032 - 40.84032 -6.39413376117

152 40.85037 - 40.94174 -6.23494117411

153 40.95032 - 41.28032 -6.39413376117

154 41.29032 - 41.37032 -6.51682873432

155 41.38032 - 41.85037 -6.39413376117

156 41.86032 - 42.75032 -6.51682873432

157 42.76037 - 42.93033 -6.39413376117

158 42.94169 - 43.02054 -6.51682873432

159 43.03037 - 43.15037 -6.39413376117

160 43.16037 - 43.58037 -6.51682873432

161 43.59033 - 44.04033 -6.39413376117

162 44.05033 - 46.56038 -6.51682873432

163 46.57033 - 46.75038 -6.39413376117

164 46.76038 - 47.37038 -6.51682873432

165 47.38038 - 47.76033 -6.39413376117

166 47.77036 - 47.92033 -6.51682873432

167 47.93032 - 48.21038 -6.39413376117

168 48.22039 - 51.12038 -6.51682873432

169 51.13036 - 51.31036 -6.39413376117

170 51.32033 - 51.62033 -6.51682873432

171 51.63032 - 51.76033 -6.39413376117

172 51.77036 - 53.37037 -6.51682873432

173 53.38032 - 53.40032 -6.23494117411

174 53.41037 - 53.50031 -6.39413376117

175 53.51033 - 53.77037 -6.51682873432

176 53.78032 - 53.79037 -6.23494117411

177 53.80114 - 53.80114 -4.87883712155

178 53.81037 - 53.81037 -6.23494117411

179 53.82032 - 53.89033 -6.39413376117

180 53.90032 - 54.00032 -6.23494117411

181 54.01036 - 54.02036 -4.87883712155

182 54.03037 - 54.08037 -6.23494117411

183 54.09032 - 54.10037 -6.39413376117

184 54.11037 - 54.41032 -6.51682873432

185 54.42032 - 54.53037 -6.39413376117

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187 54.63037 - 55.27032 -6.39413376117

188 55.28036 - 55.35032 -6.23494117411

189 55.36036 - 55.42031 -6.39413376117

190 55.43032 - 55.51037 -6.23494117411

191 55.52036 - 55.5804 -6.39413376117

192 55.59033 - 55.60032 -6.23494117411

193 55.61037 - 55.65032 -6.39413376117

194 55.66055 - 55.73037 -6.23494117411

195 55.74037 - 55.82032 -6.39413376117

196 55.83046 - 56.07032 -6.23494117411

197 56.08037 - 56.13037 -6.39413376117

198 56.14032 - 56.21032 -6.23494117411

199 56.22046 - 56.39037 -6.51682873432

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201 56.45032 - 56.59032 -6.23494117411

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203 56.61037 - 56.63036 -6.51682873432

204 56.64032 - 56.66037 -6.39413376117

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206 56.68037 - 56.81037 -6.51682873432

207 56.82037 - 56.85032 -6.39413376117

208 56.86032 - 57.02032 -6.23494117411

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211 57.34036 - 57.56032 -6.51682873432

212 57.57038 - 57.58037 -6.23494117411

213 57.59037 - 57.61032 -6.39413376117

214 57.62033 - 57.70033 -6.51682873432

215 57.71033 - 57.75032 -4.87883712155

216 57.76033 - 57.81033 -6.23494117411

217 57.82037 - 57.86036 -6.39413376117

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219 58.05116 - 58.22032 -6.39413376117

220 58.23033 - 58.31037 -6.51682873432

221 58.32032 - 58.48032 -6.39413376117

222 58.49033 - 58.64037 -6.51682873432

223 58.65037 - 58.86037 -6.39413376117

224 58.87036 - 59.01031 -6.51682873432

225 59.02032 - 59.03032 -6.23494117411

226 59.04037 - 59.13033 -6.39413376117

227 59.14036 - 59.24032 -6.51682873432

228 59.25037 - 59.36032 -6.39413376117

229 59.37033 - 59.42031 -6.51682873432

230 59.43032 - 59.44168 -6.39413376117

231 59.45032 - 59.47032 -6.23494117411

232 59.48032 - 59.54037 -6.51682873432

233 59.55032 - 59.64032 -6.39413376117

234 59.65032 - 59.82037 -6.23494117411

235 59.8304 - 60.35033 -6.39413376117

236 60.36033 - 60.37033 -6.51682873432

237 60.38037 - 60.89033 -6.39413376117

238 60.90032 - 61.39036 -6.23494117411

239 61.40032 - 61.63037 -6.39413376117

240 61.64032 - 61.70036 -6.51682873432

241 61.71032 - 61.77032 -6.23494117411

242 61.78037 - 61.95032 -6.39413376117

243 61.96037 - 62.11037 -6.23494117411

244 62.12037 - 62.13036 -6.39413376117

245 62.14033 - 64.67037 -6.51682873432

246 64.68037 - 64.70037 -6.23494117411

247 64.71037 - 66.31036 -6.51682873432

248 66.32033 - 66.52032 -6.39413376117

249 66.53037 - 66.66032 -6.51682873432

250 66.67033 - 67.20036 -6.39413376117

251 67.21037 - 67.26032 -6.51682873432

252 67.27037 - 67.35033 -6.39413376117

253 67.36032 - 67.81037 -6.51682873432

254 67.82036 - 67.90036 -6.39413376117

255 67.91031 - 67.91031 -6.23494117411

256 67.92032 - 67.92032 -4.87883712155

257 67.93032 - 67.9417 -6.23494117411

258 67.95031 - 68.09036 -6.39413376117

259 68.10033 - 68.61032 -6.51682873432

260 68.62036 - 68.71037 -6.23494117411

261 68.72032 - 69.13037 -6.39413376117

262 69.14036 - 69.28032 -6.51682873432

263 69.29033 - 69.48032 -6.39413376117

264 69.49033 - 69.57033 -6.51682873432

265 69.58036 - 70.18037 -6.39413376117

266 70.19033 - 70.21037 -6.23494117411

267 70.22037 - 70.28031 -6.39413376117

268 70.29033 - 70.32032 -6.23494117411

269 70.33037 - 70.33037 -4.87883712155

270 70.34036 - 70.34036 -6.23494117411

271 70.35037 - 70.46036 -6.39413376117

272 70.47036 - 70.57032 -6.23494117411

273 70.58048 - 70.59032 -6.39413376117

274 70.60033 - 70.66037 -6.51682873432

275 70.67036 - 70.73037 -6.39413376117

276 70.74032 - 70.84037 -4.87883712155

277 70.85032 - 70.90032 -6.23494117411

278 70.91059 - 70.93032 -4.87883712155

279 70.94032 - 71.22037 -6.23494117411

280 71.23036 - 71.26033 -6.51682873432

281 71.27032 - 71.29032 -6.39413376117

282 71.30123 - 71.31031 -6.23494117411

283 71.32037 - 71.39033 -6.39413376117

284 71.40032 - 72.24033 -6.51682873432

285 72.25033 - 72.26031 -6.23494117411

286 72.27032 - 72.3011 -6.39413376117

287 72.31037 - 73.06037 -6.51682873432

288 73.07037 - 73.26037 -6.39413376117

289 73.27037 - 73.38032 -6.51682873432

290 73.39033 - 73.67037 -6.39413376117

291 73.68046 - 73.84032 -6.23494117411

292 73.85032 - 74.08041 -6.39413376117

293 74.09032 - 74.49037 -6.23494117411

294 74.50037 - 75.73036 -6.39413376117

295 75.74033 - 75.75036 -6.23494117411

296 75.76038 - 75.80033 -4.87883712155

297 75.81031 - 75.81031 -6.23494117411

298 75.82033 - 75.82033 -4.87883712155

299 75.83032 - 75.88037 -6.23494117411

300 75.89031 - 75.90033 -4.87883712155

301 75.91059 - 75.92038 -6.23494117411

302 75.93036 - 78.71045 -4.87883712155

303 78.72033 - 78.75033 -6.23494117411

304 78.76037 - 80.12032 -4.87883712155

305 80.13033 - 80.19172 -6.23494117411

306 80.20036 - 80.26031 -4.87883712155

307 80.27076 - 80.27076 -6.23494117411

308 80.28033 - 88.45038 -4.87883712155

309 88.46037 - 88.51032 -6.23494117411

310 88.52055 - 88.53033 -4.87883712155

311 88.54045 - 88.59033 -6.23494117411

312 88.60036 - 88.75033 -6.39413376117

313 88.76036 - 88.84032 -6.23494117411

314 88.85033 - 88.85033 -4.87883712155

315 88.86036 - 88.90031 -6.23494117411

316 88.9447 - 91.95069 -4.11191426595

317 91.96208 - 92.00533 -4.87883712155

318 92.01037 - 92.05037 -6.23494117411

319 92.06036 - 92.11037 -4.87883712155

320 92.12037 - 92.27033 -6.23494117411

321 92.28032 - 92.30113 -4.87883712155

322 92.31033 - 92.62037 -6.51682873432

323 92.63036 - 92.70032 -6.39413376117

324 92.71032 - 92.95036 -6.51682873432

325 92.96033 - 93.09031 -6.23494117411

326 93.10038 - 93.17036 -6.39413376117

327 93.18037 - 93.37036 -6.51682873432

328 93.38038 - 93.39036 -6.23494117411

329 93.40038 - 93.40038 -4.87883712155

330 93.41036 - 93.42033 -6.23494117411

331 93.43031 - 93.44172 -6.39413376117

332 93.45036 - 95.97037 -6.51682873432

333 95.98032 - 96.11033 -6.39413376117

334 96.12033 - 96.34037 -6.51682873432

335 96.35037 - 96.54032 -6.39413376117

336 96.55037 - 96.59037 -6.51682873432

337 96.6004 - 96.73038 -6.39413376117

338 96.74032 - 96.79033 -6.23494117411

339 96.80111 - 96.83049 -6.39413376117

340 96.84032 - 96.96032 -6.51682873432

341 96.97037 - 96.98037 -6.23494117411

342 96.99056 - 97.00037 -6.39413376117

343 97.01037 - 97.99037 -6.51682873432

344 98.00032 - 98.38037 -6.39413376117

345 98.39032 - 98.60037 -6.23494117411

346 98.61037 - 99.22032 -6.39413376117

347 99.23037 - 99.37033 -6.23494117411

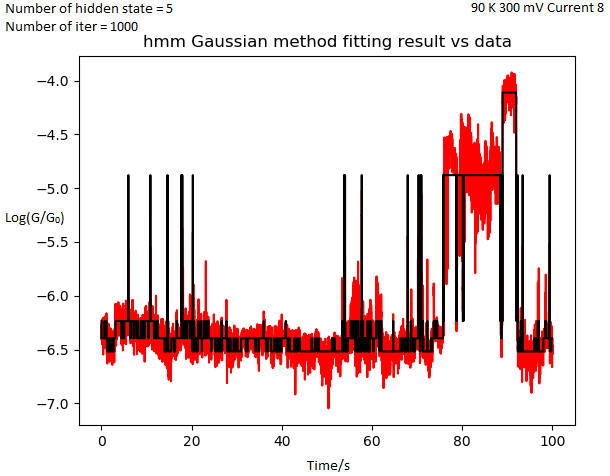
348 99.38032 - 99.38032 -4.87883712155

349 99.39033 - 99.47049 -6.51682873432

350 99.48032 - 99.66036 -6.39413376117

351 99.67038 - 99.76032 -6.51682873432

352 99.77037 - 99.90033 -6.39413376117



n component = 2, n iter = 1000

90K 300 mV Current 10 (0 to 27s)

done fitting to HMM

Transition matrix

[[0.99558561 0.00441439]

[0.00734459 0.99265541]]

Means and Variance of each hidden state

0th hidden state

mean = [-5.86982027]

variance = [0.01494534]

1th hidden state

mean = [-4.73273568]

variance = [0.05718628]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 0.05037 - 8.69033 -5.8698202658

1 8.70037 - 13.87037 -4.73273568229

2 13.88032 - 19.47032 -5.8698202658

3 19.48032 - 20.64037 -4.73273568229

4 20.65032 - 20.67032 -5.8698202658

5 20.68032 - 20.71037 -4.73273568229

6 20.72037 - 23.26037 -5.8698202658

7 23.27032 - 26.15032 -4.73273568229

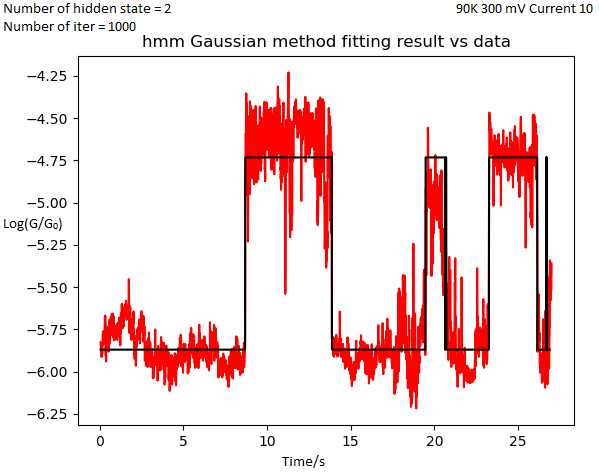
8 26.16032 - 26.68031 -5.8698202658

9 26.69036 - 26.69036 -4.73273568229

10 26.70033 - 26.71032 -5.8698202658

11 26.72037 - 26.73032 -4.73273568229

12 26.74032 - 26.90037 -5.8698202658

****

n component = 4, n iter = 1000

90K 300 mV Current 10 (70 to 80s)

done fitting to HMM

Transition matrix

[[0.87899284 0.06238439 0.00386655 0.05475621]

[0.07632991 0.9142483 0.00424242 0.00517937]

[0.02136816 0.02086921 0.88273443 0.07502821]

[0.1229646 0.00330541 0.06480725 0.80892274]]

Means and Variance of each hidden state

0th hidden state

mean = [-5.94593201]

variance = [0.00159304]

1th hidden state

mean = [-6.0147808]

variance = [0.0029044]

2th hidden state

mean = [-5.43914128]

variance = [0.05837712]

3th hidden state

mean = [-5.83528593]

variance = [0.00402111]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 70.01032 - 70.15032 -5.94593201357

1 70.16046 - 70.19032 -5.83528593029

2 70.20037 - 70.31052 -5.94593201357

3 70.32033 - 70.39037 -6.01478080145

4 70.40037 - 70.61032 -5.94593201357

5 70.62032 - 70.63032 -5.83528593029

6 70.64032 - 70.68032 -5.43914127942

7 70.69032 - 70.70032 -5.83528593029

8 70.71037 - 70.85032 -5.43914127942

9 70.86037 - 70.90033 -5.83528593029

10 70.91036 - 70.93032 -5.43914127942

11 70.94057 - 71.00033 -5.94593201357

12 71.01032 - 71.02033 -5.83528593029

13 71.03036 - 71.03036 -5.43914127942

14 71.04033 - 71.07036 -5.83528593029

15 71.08032 - 71.20032 -5.94593201357

16 71.21032 - 71.22032 -5.83528593029

17 71.23032 - 72.22038 -5.94593201357

18 72.23038 - 72.29038 -5.83528593029

19 72.30036 - 72.37033 -5.94593201357

20 72.38036 - 72.60036 -6.01478080145

21 72.61058 - 72.64038 -5.94593201357

22 72.65036 - 72.66033 -5.83528593029

23 72.67033 - 72.89145 -5.94593201357

24 72.90033 - 72.93038 -6.01478080145

25 72.94038 - 73.21038 -5.94593201357

26 73.22038 - 73.25038 -5.83528593029

27 73.26033 - 73.37031 -5.94593201357

28 73.38037 - 73.52033 -5.83528593029

29 73.53032 - 73.57036 -5.94593201357

30 73.58033 - 73.69036 -5.83528593029

31 73.70033 - 73.71036 -5.94593201357

32 73.72046 - 73.77032 -5.83528593029

33 73.78115 - 73.78115 -5.94593201357

34 73.79032 - 74.07037 -6.01478080145

35 74.08037 - 74.09037 -5.94593201357

36 74.10033 - 74.11033 -5.83528593029

37 74.12033 - 74.14033 -5.94593201357

38 74.15033 - 74.21037 -6.01478080145

39 74.22033 - 74.36033 -5.94593201357

40 74.37032 - 74.71033 -6.01478080145

41 74.72033 - 74.79033 -5.94593201357

42 74.80037 - 74.83037 -5.83528593029

43 74.84033 - 74.85037 -5.94593201357

44 74.86037 - 74.89037 -5.83528593029

45 74.90038 - 74.91032 -5.94593201357

46 74.92045 - 75.22033 -6.01478080145

47 75.23037 - 75.52033 -5.43914127942

48 75.53116 - 75.56033 -5.94593201357

49 75.57037 - 75.58033 -5.83528593029

50 75.59037 - 75.71037 -5.94593201357

51 75.72037 - 75.90032 -6.01478080145

52 75.91037 - 75.97033 -5.83528593029

53 75.98037 - 76.19032 -5.43914127942

54 76.20037 - 76.29037 -5.83528593029

55 76.30033 - 76.38033 -5.43914127942

56 76.39037 - 76.42043 -5.83528593029

57 76.43036 - 76.43036 -5.43914127942

58 76.44033 - 76.53037 -5.83528593029

59 76.54032 - 76.63037 -5.94593201357

60 76.64032 - 76.70032 -6.01478080145

61 76.71033 - 76.72032 -5.94593201357

62 76.73038 - 76.83033 -5.83528593029

63 76.84037 - 76.88032 -5.94593201357

64 76.89038 - 77.19033 -6.01478080145

65 77.20036 - 77.26036 -5.94593201357

66 77.27032 - 77.29038 -5.83528593029

67 77.30036 - 77.30036 -5.94593201357

68 77.31033 - 77.32036 -6.01478080145

69 77.33037 - 77.34032 -5.94593201357

70 77.35033 - 77.37033 -5.83528593029

71 77.38036 - 77.3914 -5.43914127942

72 77.40032 - 77.61033 -5.83528593029

73 77.62031 - 77.80036 -5.94593201357

74 77.81057 - 78.04037 -6.01478080145

75 78.05032 - 78.34037 -5.94593201357

76 78.35032 - 78.46033 -6.01478080145

77 78.47032 - 78.54032 -5.94593201357

78 78.55036 - 78.62033 -6.01478080145

79 78.63031 - 78.69037 -5.94593201357

80 78.70033 - 78.81032 -6.01478080145

81 78.82032 - 78.92033 -5.43914127942

82 78.93037 - 79.19032 -6.01478080145

83 79.20033 - 79.32036 -5.94593201357

84 79.33037 - 79.35033 -5.43914127942

85 79.36032 - 79.38037 -5.83528593029

86 79.39139 - 79.39139 -5.43914127942

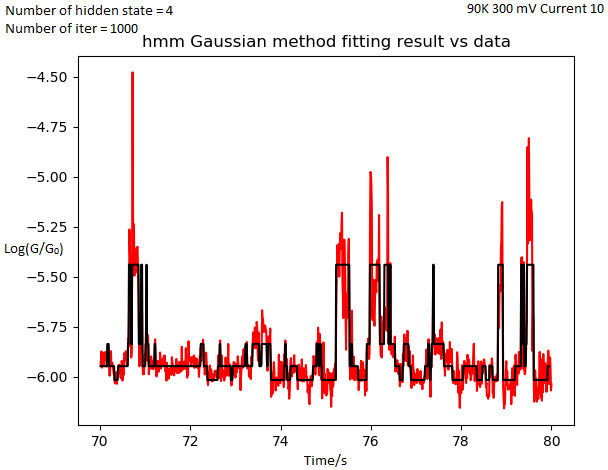
87 79.40033 - 79.43032 -5.94593201357

88 79.44033 - 79.45037 -5.83528593029

89 79.46037 - 79.60031 -5.43914127942

90 79.61033 - 79.91037 -6.01478080145

91 79.92032 - 79.94032 -5.94593201357



n component = 2, n iter = 1000

90K 300 mV Current 10 (70 to 80s)

done fitting to HMM

Transition matrix

[[0.98473154 0.01526846]

[0.06820003 0.93179997]]

Means and Variance of each hidden state

0th hidden state

mean = [-5.96103887]

variance = [0.00472524]

1th hidden state

mean = [-5.56765192]

variance = [0.06966272]

Record of all hidden state

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

No. TIME Start - TIME End VALUE

0 70.01032 - 70.63032 -5.96103886777

1 70.64032 - 70.93032 -5.56765192449

2 70.94057 - 71.01032 -5.96103886777

3 71.02033 - 71.03036 -5.56765192449

4 71.04033 - 73.38037 -5.96103886777

5 73.3914 - 73.48038 -5.56765192449

6 73.49036 - 73.58033 -5.96103886777

7 73.59032 - 73.77032 -5.56765192449

8 73.78115 - 75.22033 -5.96103886777

9 75.23037 - 75.52033 -5.56765192449

10 75.53116 - 75.56033 -5.96103886777

11 75.57037 - 75.58033 -5.56765192449

12 75.59037 - 75.97033 -5.96103886777

13 75.98037 - 76.43036 -5.56765192449

14 76.44033 - 77.36032 -5.96103886777

15 77.37033 - 77.41038 -5.56765192449

16 77.42042 - 78.81032 -5.96103886777

17 78.82032 - 78.92033 -5.56765192449

18 78.93037 - 79.32036 -5.96103886777

19 79.33037 - 79.39139 -5.56765192449

20 79.40033 - 79.43032 -5.96103886777

21 79.44033 - 79.60031 -5.56765192449

