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]

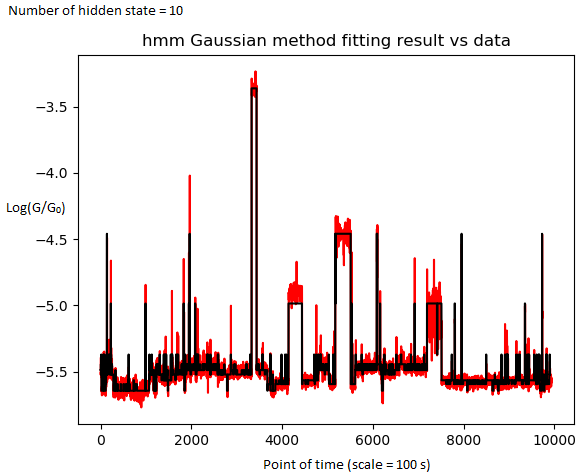
var = [0.00044852]

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]

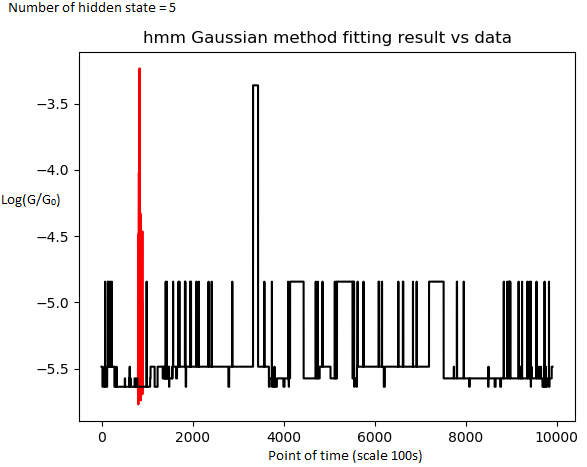
var = [0.09032678]

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]

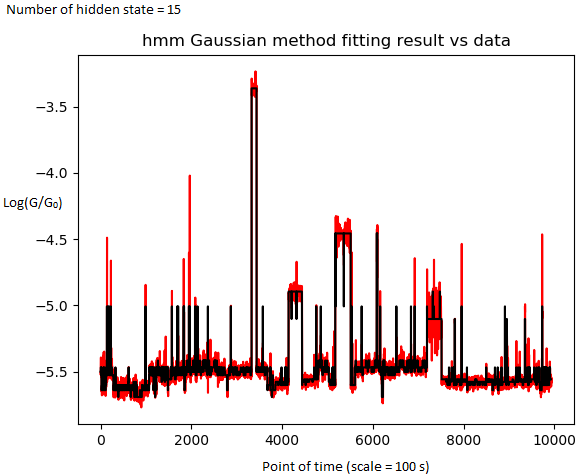
var = [0.00028073]

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]

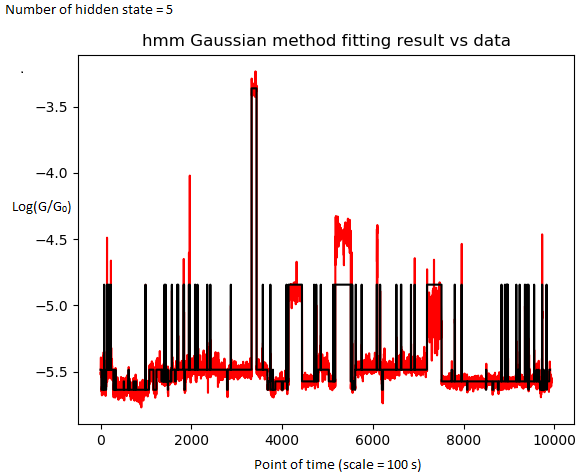
var = [0.00147555]

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

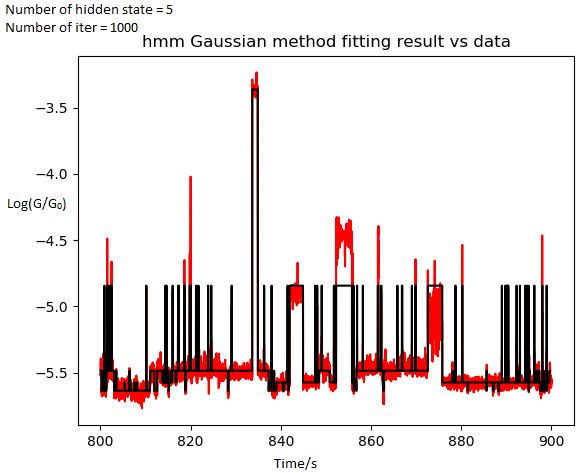
202 898.51036 - 898.93032 -5.57454728509

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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