EDA

March 4, 2020

```
In [1]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import seaborn as sns
        %matplotlib inline

In [132]: from sklearn.metrics import mean_squared_error

In [2]: %load_ext autoreload
        %autoreload 2

In [3]: df = pd.read_csv('processed-temperature.csv')

In [4]: df.columns

Out[4]: Index(['Date', 'temperature'], dtype='object')

In [5]: rain = pd.read_csv('chennai_reservoir_rainfall.csv')

In [6]: type(rain["Date"])

Out[6]: pandas.core.series.Series

In [7]: type(df["Date"])

Out[7]: pandas.core.series.Series

In [8]: rain.head()

Out[8]:          Date  POONDI  CHOLAVARAM  REDHILLS  CHEMBARAMBAKKAM
        0  01-01-2004     0.0         0.0       0.0              0.0
        1  02-01-2004     0.0         0.0       0.0              0.0
        2  03-01-2004     0.0         0.0       0.0              0.0
        3  04-01-2004     0.0         0.0       0.0              0.0
        4  05-01-2004     0.0         0.0       0.0              0.0

In [9]: rain["Date"] = pd.to_datetime(rain["Date"], format='%d-%m-%Y')

In [10]: rain["Date"] = pd.to_datetime(rain["Date"], format='%m-%d-%Y')
```

```
In [11]: rain.head()
```

Out[11]:

	Date	POONDI	CHOLAVARAM	REDHILLS	CHEMBARAMBAKKAM
0	2004-01-01	0.0	0.0	0.0	0.0
1	2004-01-02	0.0	0.0	0.0	0.0
2	2004-01-03	0.0	0.0	0.0	0.0
3	2004-01-04	0.0	0.0	0.0	0.0
4	2004-01-05	0.0	0.0	0.0	0.0

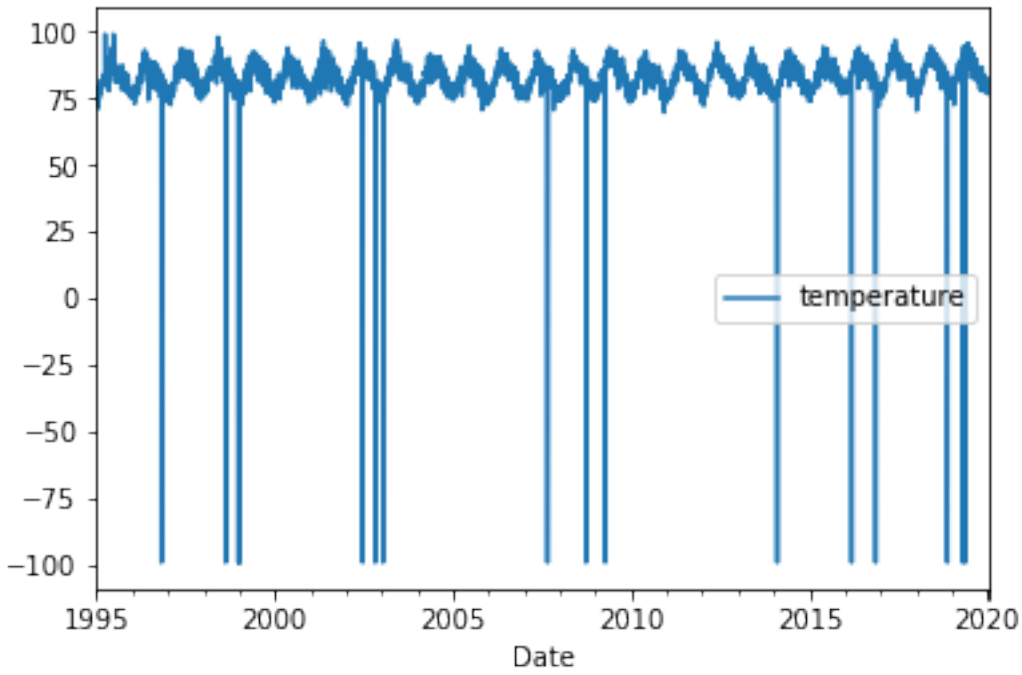
```
In [12]: df["Date"] = pd.to_datetime(df["Date"], format='%m-%d-%Y')

In [13]: df.head()
```

Out[13]:

	Date	temperature
0	1995-01-01	72.4
1	1995-01-02	73.5
2	1995-01-03	72.6
3	1995-01-04	75.2
4	1995-01-05	74.8

```
In [14]: df.plot(x='Date')
```

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd44941efd0>




```
In [15]: df.loc[df['temperature'] < 0]
```

Out[15]:

	Date	temperature
664	1996-10-26	-99.0
1323	1998-08-16	-99.0
1453	1998-12-24	-99.0
1454	1998-12-25	-99.0
1459	1998-12-30	-99.0
1460	1998-12-31	-99.0
1470	1999-01-10	-99.0
2725	2002-06-18	-99.0
2726	2002-06-19	-99.0
2727	2002-06-20	-99.0
2728	2002-06-21	-99.0
2855	2002-10-26	-99.0
2934	2003-01-13	-99.0
4622	2007-08-28	-99.0
5015	2008-09-24	-99.0
5212	2009-04-09	-99.0
6976	2014-02-06	-99.0
7739	2016-03-10	-99.0
7985	2016-11-11	-99.0
8718	2018-11-14	-99.0
8721	2018-11-17	-99.0
8879	2019-04-24	-99.0
8901	2019-05-16	-99.0
8902	2019-05-17	-99.0
8903	2019-05-18	-99.0

```
In [16]: idx = df.loc[df["temperature"] < 0].index
```

```
In [17]: for i in range(-4,5):
             print(df.iloc[idx[0] + i]['temperature'])
```

```
82.9
82.1
79.6
84.3
-99.0
83.7
81.0
82.0
81.4
```

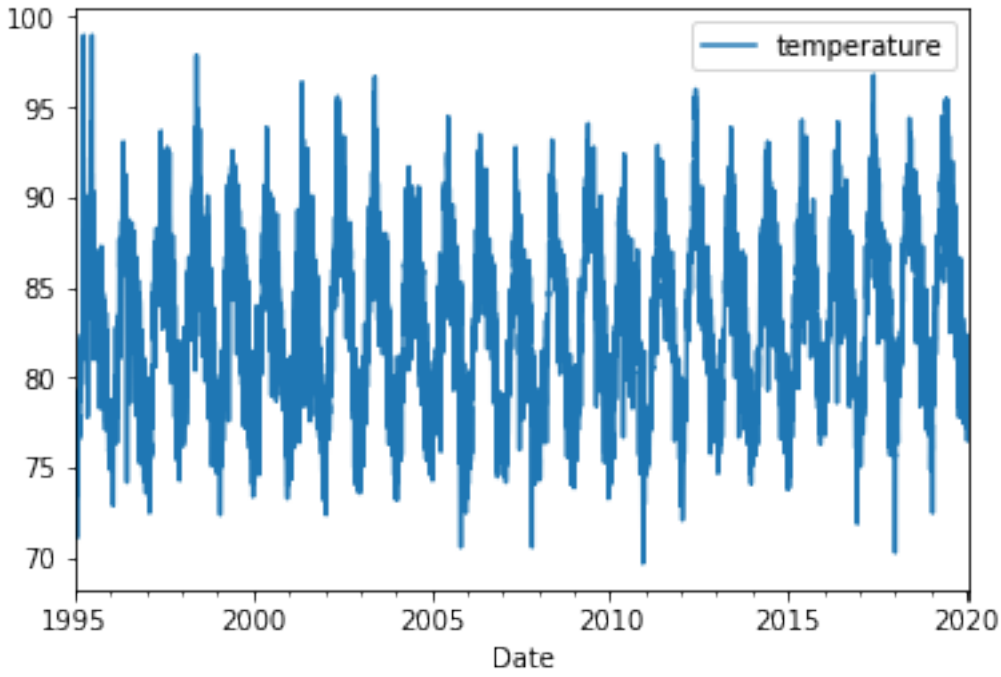
```
In [18]: idx = df.loc[df['temperature'] < 0].index
```

```
In [19]: for i in idx:
             if df.iloc[i+1][1] > 0:
                 df.iloc[i,1] = (df.iloc[i-1, 1] + df.iloc[i+1, 1]) / 2
             else:
                 df.iloc[i,1] = (df.iloc[i-1, 1])
```

In [20]:
```
# for i in idx:
#     for j in range(-4,5):
#         print(df.iloc[i + j]['temperature'])
```

In [21]:
```
df.plot(x='Date')
```

Out[21]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd44b927668>
```



In [22]:
```
df.describe()
```

Out[22]:

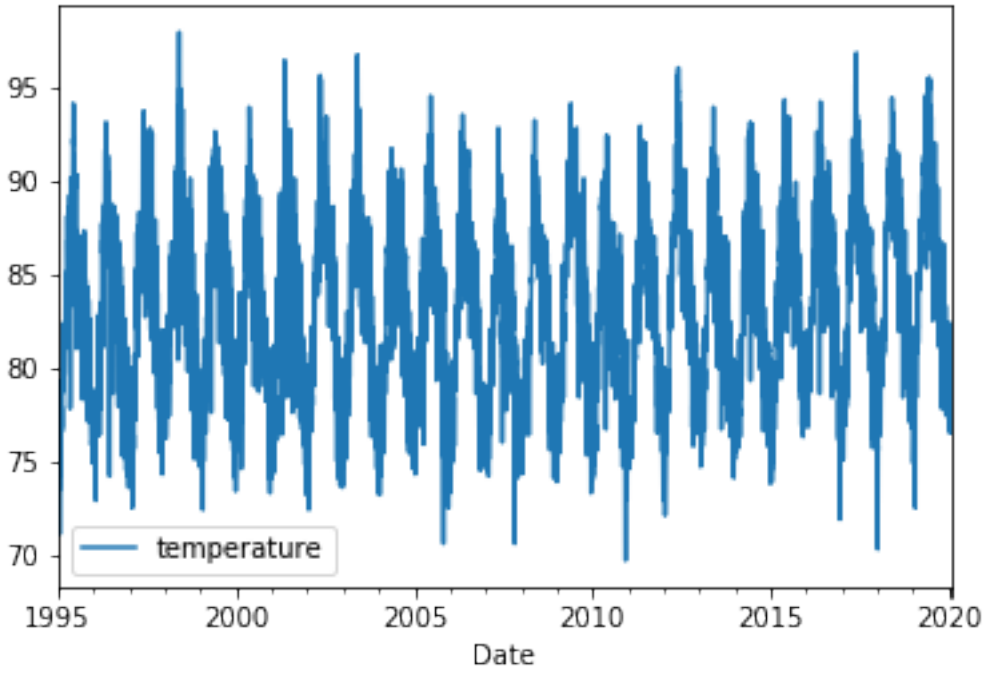
	temperature
count	9158.000000
mean	83.407043
std	4.730817
min	69.700000
25%	79.400000
50%	83.800000
75%	87.000000
max	99.000000

In [23]:
```
df.loc[df['temperature'] >= 99]
```

Out[23]:

	Date	temperature
87	1995-03-29	99.0
172	1995-06-22	99.0

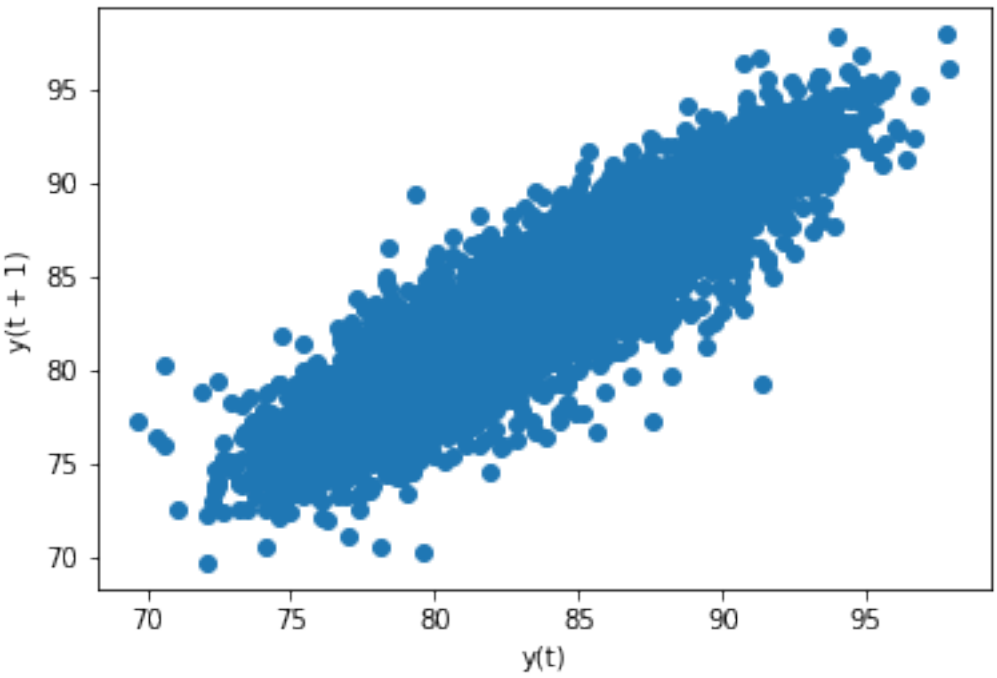
```
In [24]: idx = df.loc[df['temperature'] >= 99].index

In [25]: for i in range(-4,5):
             print(df.iloc[87 + i]['temperature'])

84.0
84.2
82.6
84.2
99.0
85.1
84.3
84.7
84.6


In [26]: for i in range(-4,5):
             print(df.iloc[172 + i]['temperature'])

89.7
89.9
91.3
86.5
99.0
84.1
85.6
85.1
87.4


In [27]: for i in idx:
             if df.iloc[i+1][1] < 99:
                 df.iloc[i,1] = (df.iloc[i-1, 1] + df.iloc[i+1, 1]) / 2
             else:
                 df.iloc[i,1] = (df.iloc[i-1, 1])

In [28]: df.plot(x='Date')

Out[28]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd44b848ac8>
```



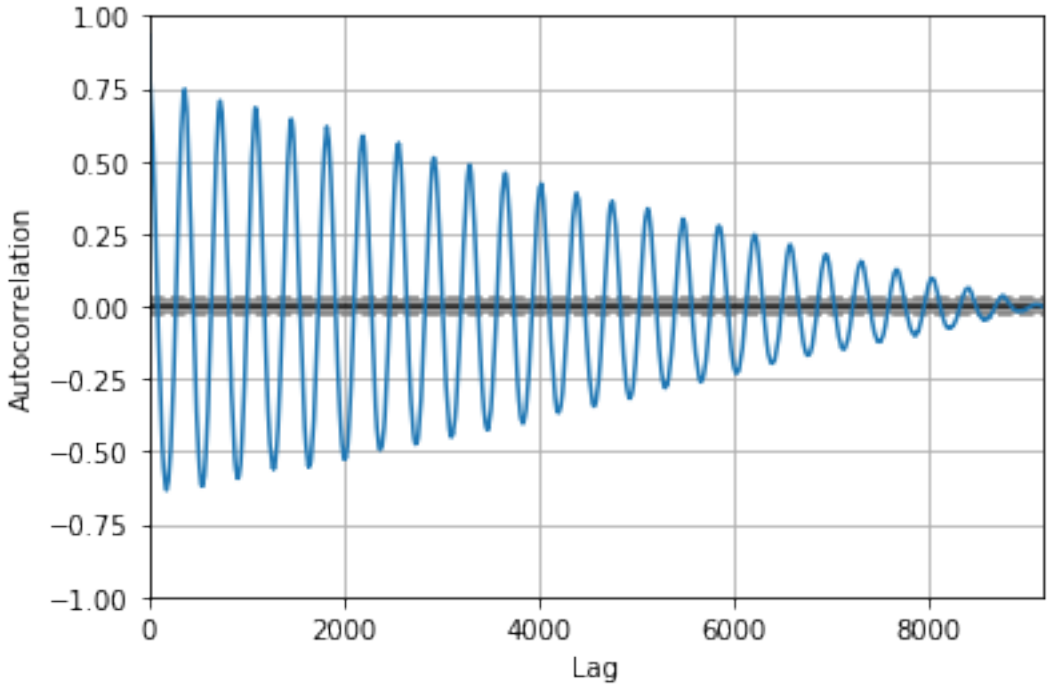

```
In [29]: df.describe()

Out[29]:        temperature
         count   9158.00000
         mean      83.40398
         std        4.72526
         min       69.70000
         25%       79.40000
         50%       83.80000
         75%       87.00000
         max       97.90000

In [30]: idx = df.loc[df['temperature'] == max(df["temperature"])].index

In [31]: for i in range(-4,5):
             print(df.loc[idx + i])

           Date  temperature
1239 1998-05-24         93.8
           Date  temperature
1240 1998-05-25         93.1
           Date  temperature
1241 1998-05-26         94.0
           Date  temperature
1242 1998-05-27         97.8
```

```
           Date  temperature
1243 1998-05-28         97.9
           Date  temperature
1244 1998-05-29         96.1
           Date  temperature
1245 1998-05-30         92.6
           Date  temperature
1246 1998-05-31         92.5
           Date  temperature
1247 1998-06-01         91.4
```

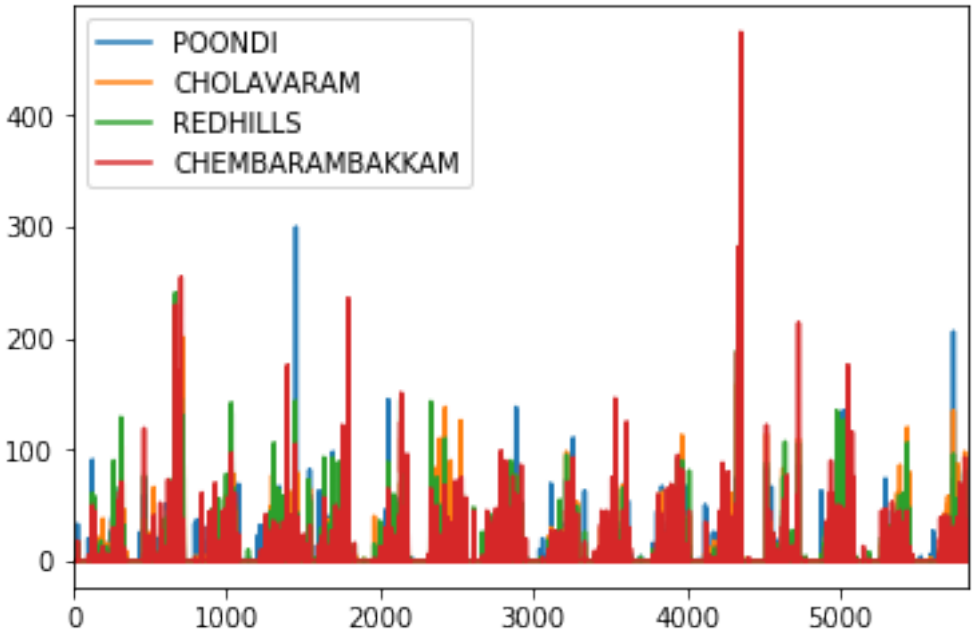
```
In [48]: df.shape

Out[48]: (9158, 2)

In [59]: dff = df.temperature

In [61]: df.to_csv('processed-temperature.csv')

In [32]: from pandas.plotting import lag_plot

In [33]: lag_plot(df['temperature'])

Out[33]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd4493686d8>
```



```
In [34]: df.values

Out[34]: array([[Timestamp('1995-01-01 00:00:00'), 72.4],
                [Timestamp('1995-01-02 00:00:00'), 73.5],
                [Timestamp('1995-01-03 00:00:00'), 72.6],
                ...,
                [Timestamp('2020-01-25 00:00:00'), 76.8],
                [Timestamp('2020-01-26 00:00:00'), 78.7],
                [Timestamp('2020-01-27 00:00:00'), 80.0]], dtype=object)

In [35]: dataframe = pd.concat([df['temperature'].shift(1), df.temperature], axis=1)
         dataframe.columns = ['t-1', 't+1']
         result = dataframe.corr()
         print(result)

           t-1       t+1
t-1   1.000000  0.933585
t+1   0.933585  1.000000


In [36]: from pandas.plotting import autocorrelation_plot

In [37]: autocorrelation_plot(df['temperature'])

Out[37]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd44baeb4e0>
```

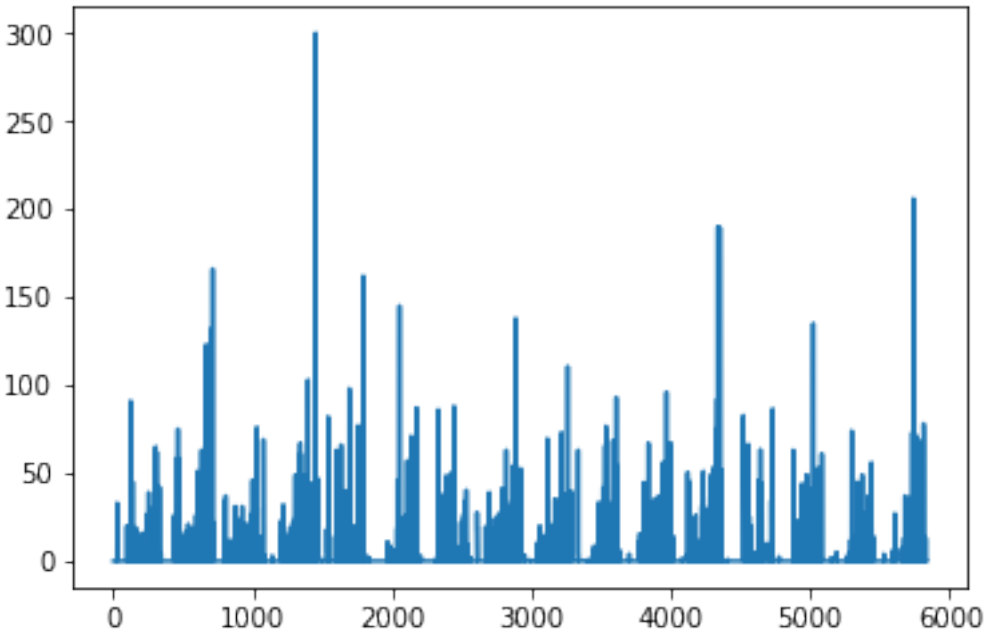


```
In [38]: autocorrelation_plot?

In [39]: import keras

Using TensorFlow backend.


In [40]: from keras import layers

In [41]: from keras import Sequential

In [42]: model = Sequential()

         model.add(layers.Embedding(input_dim=1000, output_dim=64))

         model.add(layers.LSTM(128))

         model.add(layers.Dense(10))

         model.summary()

WARNING:tensorflow:From /home/vigneshwaran/environments/base/lib/python3.6/site-packages/tenso
Instructions for updating:
Colocations handled automatically by placer.
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_1 (Embedding)      (None, None, 64)          64000
_________________________________________________________________
lstm_1 (LSTM)                (None, 128)               98816
_________________________________________________________________
dense_1 (Dense)              (None, 10)                1290
=================================================================
Total params: 164,106
Trainable params: 164,106
Non-trainable params: 0
_________________________________________________________________


In [43]: model.fit?

In [47]: rain = pd.read_csv('chennai_reservoir_rainfall.csv')

In [48]: rain.plot()

Out[48]: <matplotlib.axes._subplots.AxesSubplot at 0x7fcd6c42d828>
```



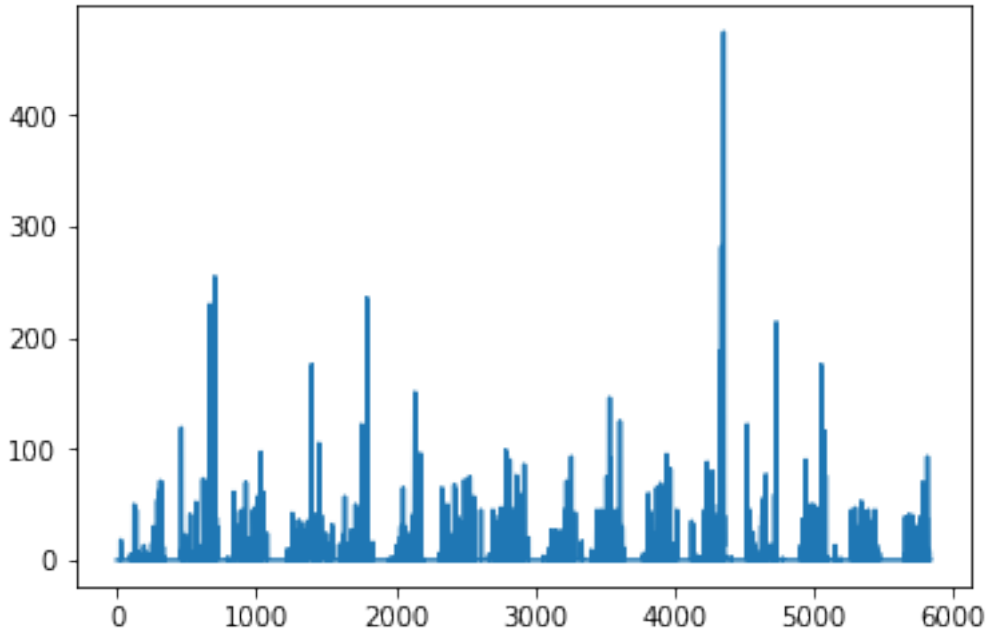

```
In [49]: plt.plot(rain['POONDI'])
```

```
Out[49]: [<matplotlib.lines.Line2D at 0x7fcd6c367240>]
```



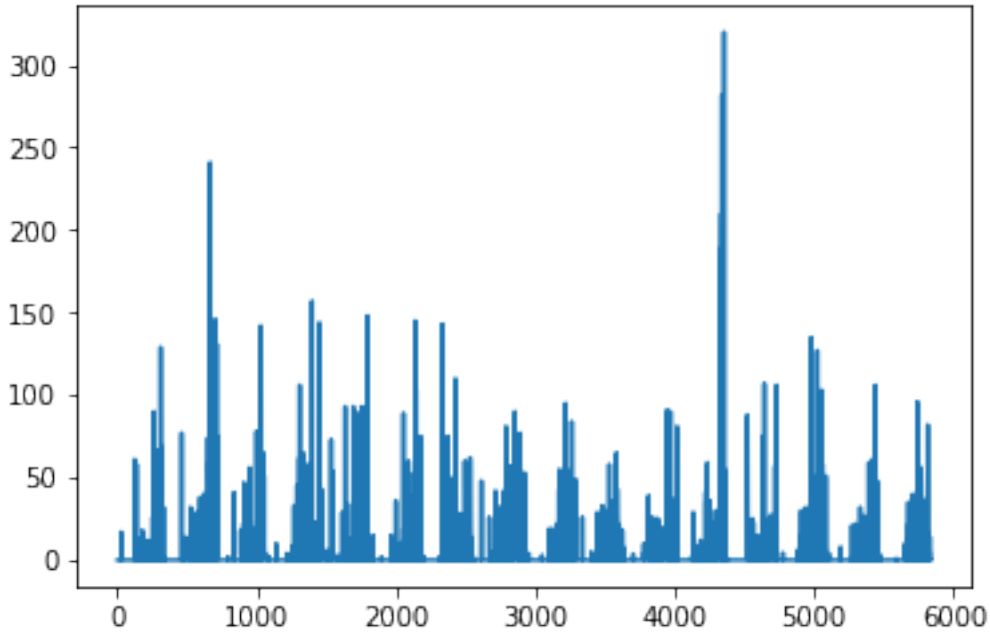
In [50]: plt.plot(rain['CHEMBARAMBAKKAM'])

Out[50]: [<matplotlib.lines.Line2D at 0x7fcd6c3313c8>]

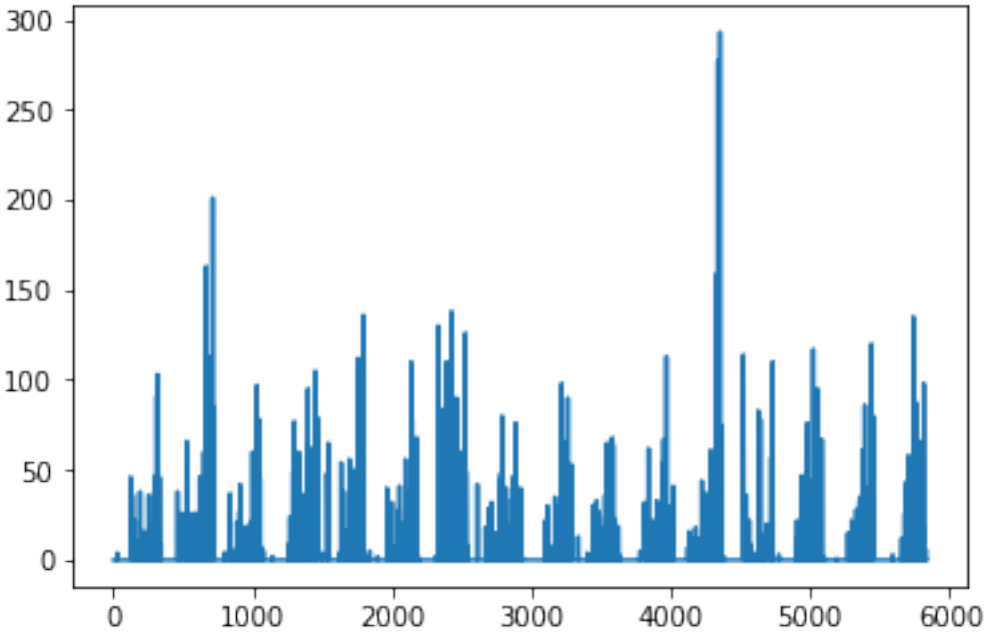


In [51]: plt.plot(rain['REDHILLS'])

Out[51]: [<matplotlib.lines.Line2D at 0x7fcd6c2f1c18>]



```
In [52]: plt.plot(rain['CHOLAVARAM'])

Out[52]: [<matplotlib.lines.Line2D at 0x7fcd6c2413c8>]
```




```
In [64]: values = pd.DataFrame(df['temperature'].values)
         dataframe = pd.concat([values.shift(1), values], axis=1)
         dataframe.columns = ['t-1', 't+1']
         X = dataframe.values
         train, test = X[1:len(X)-7], X[len(X)-7:]
         train_X, train_y = train[:,0], train[:,1]
         test_X, test_y = test[:,0], test[:,1]

In [83]: values = pd.DataFrame(df['temperature'].values)

In [87]:

Out[87]: array([[ nan, 72.4],
                [72.4, 73.5],
                [73.5, 72.6],
                ...,
                [77.8, 76.8],
                [76.8, 78.7],
                [78.7, 80. ]])
```

```
In [65]: import keras

In [66]: from keras import layers

In [67]: from keras import Sequential

In [68]: from keras import backend as K
         cfg = K.tf.ConfigProto()
         cfg.gpu_options.allow_growth = True
         K.set_session(K.tf.Session(config=cfg))

In [222]: model = Sequential()

          model.add(layers.Embedding(input_dim=1000, output_dim=64))

          model.add(layers.SimpleRNN(32))

          model.add(layers.Dense(1))

          model.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_10 (Embedding)     (None, None, 64)          64000
_________________________________________________________________
simple_rnn_7 (SimpleRNN)     (None, 32)                3104
_________________________________________________________________
dense_6 (Dense)              (None, 1)                 33
=================================================================
Total params: 67,137
Trainable params: 67,137
Non-trainable params: 0
_________________________________________________________________
```

```
In [223]: #series.shape

In [224]: x = train_X

In [225]: y = train_y

In [226]: model.compile(loss='mae', optimizer='adam', metrics=['accuracy'])

In [231]: model.fit(x, y, epochs=20, batch_size=64)
```

```
Epoch 1/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.9561 - acc: 0.0162
Epoch 2/20
9150/9150 [==============================] - 0s 15us/step - loss: 1.7303 - acc: 0.0223
```

```
Epoch 3/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.5872 - acc: 0.0219
Epoch 4/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.4945 - acc: 0.0215
Epoch 5/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.4398 - acc: 0.0225
Epoch 6/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3975 - acc: 0.0223
Epoch 7/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3718 - acc: 0.0246
Epoch 8/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3511 - acc: 0.0243
Epoch 9/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3421 - acc: 0.0234
Epoch 10/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3356 - acc: 0.0249
Epoch 11/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3223 - acc: 0.0264
Epoch 12/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3219 - acc: 0.0232
Epoch 13/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3123 - acc: 0.0235
Epoch 14/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3165 - acc: 0.0242
Epoch 15/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3084 - acc: 0.0264
Epoch 16/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3106 - acc: 0.0267
Epoch 17/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3069 - acc: 0.0252
Epoch 18/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3023 - acc: 0.0249
Epoch 19/20
9150/9150 [==============================] - 0s 16us/step - loss: 1.3015 - acc: 0.0264
Epoch 20/20
9150/9150 [==============================] - 0s 17us/step - loss: 1.3031 - acc: 0.0243
```

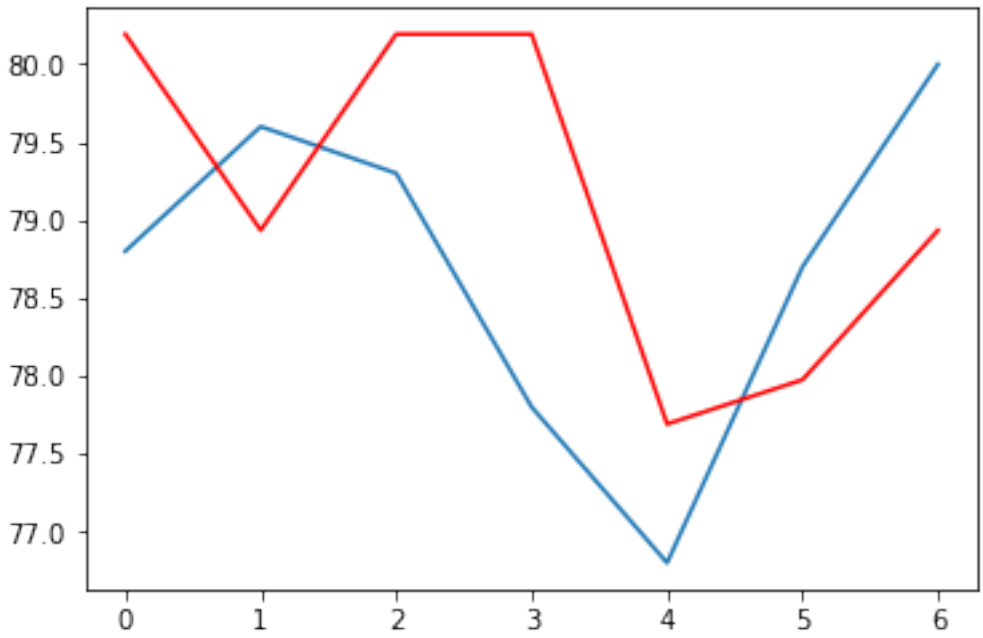
```
Out[231]: <keras.callbacks.History at 0x7fd326e934a8>
```

```
In [232]: test_Res = model.predict(test_X)
```

```
In [233]: mean_squared_error(test_Res, test_y)
```

```
Out[233]: 1.6229071366121768
```

```
In [234]: plt.plot(test_y)
          plt.plot(test_Res, color='red')
          plt.show()
```




```
In [141]: model1 = Sequential()

          model1.add(layers.Embedding(input_dim=1000, output_dim=64))

          model1.add(layers.LSTM(64))

          model1.add(layers.Dense(1))

          model1.summary()
```

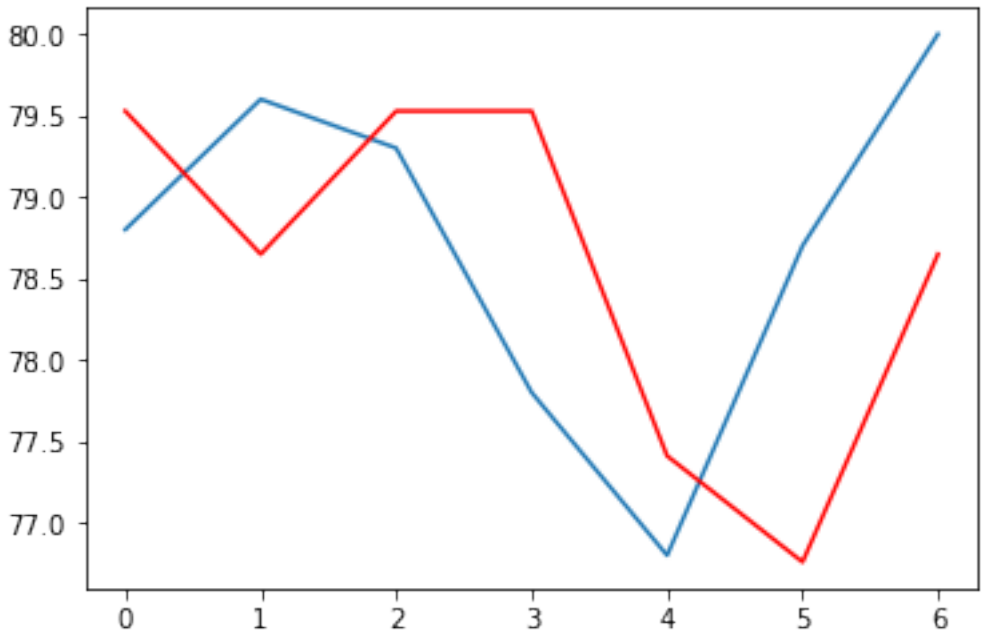
```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_9 (Embedding)      (None, None, 64)          64000
_________________________________________________________________
lstm_3 (LSTM)                (None, 64)                33024
_________________________________________________________________
dense_5 (Dense)              (None, 1)                 65
=================================================================
Total params: 97,089
Trainable params: 97,089
Non-trainable params: 0
_________________________________________________________________
```

```
In [142]: model1.compile(loss='mae', optimizer='adam', metrics=['accuracy'])
```

```
In [218]: model1.fit(x, y, epochs=20, batch_size=64)

Epoch 1/20
9150/9150 [==============================] - 0s 26us/step - loss: 1.2691 - acc: 0.0263
Epoch 2/20
9150/9150 [==============================] - 0s 27us/step - loss: 1.2707 - acc: 0.0247
Epoch 3/20
9150/9150 [==============================] - 0s 28us/step - loss: 1.2720 - acc: 0.0258
Epoch 4/20
9150/9150 [==============================] - 0s 27us/step - loss: 1.2726 - acc: 0.0255
Epoch 5/20
9150/9150 [==============================] - 0s 27us/step - loss: 1.2708 - acc: 0.0243
Epoch 6/20
9150/9150 [==============================] - 0s 27us/step - loss: 1.2703 - acc: 0.0247
Epoch 7/20
9150/9150 [==============================] - 0s 27us/step - loss: 1.2722 - acc: 0.0247
Epoch 8/20
9150/9150 [==============================] - 0s 31us/step - loss: 1.2731 - acc: 0.0252
Epoch 9/20
9150/9150 [==============================] - 0s 29us/step - loss: 1.2721 - acc: 0.0249
Epoch 10/20
9150/9150 [==============================] - 0s 28us/step - loss: 1.2715 - acc: 0.0257
Epoch 11/20
9150/9150 [==============================] - 0s 34us/step - loss: 1.2730 - acc: 0.0250
Epoch 12/20
9150/9150 [==============================] - 0s 27us/step - loss: 1.2706 - acc: 0.0259
Epoch 13/20
9150/9150 [==============================] - 0s 26us/step - loss: 1.2726 - acc: 0.0245
Epoch 14/20
9150/9150 [==============================] - 0s 36us/step - loss: 1.2736 - acc: 0.0263
Epoch 15/20
9150/9150 [==============================] - 0s 29us/step - loss: 1.2722 - acc: 0.0256
Epoch 16/20
9150/9150 [==============================] - 0s 26us/step - loss: 1.2758 - acc: 0.0247
Epoch 17/20
9150/9150 [==============================] - 0s 27us/step - loss: 1.2773 - acc: 0.0246
Epoch 18/20
9150/9150 [==============================] - 0s 32us/step - loss: 1.2715 - acc: 0.0250
Epoch 19/20
9150/9150 [==============================] - 0s 31us/step - loss: 1.2705 - acc: 0.0260
Epoch 20/20
9150/9150 [==============================] - 0s 31us/step - loss: 1.2716 - acc: 0.0254


Out[218]: <keras.callbacks.History at 0x7fd327581b38>

In [219]: test_LS = model1.predict(test_X)

In [220]: mean_squared_error(test_LS, test_y)
```

Out[220]: 1.4905017587825284

In [221]:
```
plt.plot(test_y)
plt.plot(test_LS, color='red')
plt.show()
```



In [ ]: