temperature_daily_series

January 21, 2019

1 Analysis of time series data

Temperature daily series for 10 years reported for several stations. The pipeline involves cleaning and preprocessing before trying a few time-series techniques.

```
In [161]: import os
          import pandas as pd
          import numpy as np
          os.listdir()
```

```
Out[161]: ['.ipynb_checkpoints',
           'brush_up.py',
           'chile-variety-heat-levels.csv',
           'Cleaning temperature data.ipynb',
           'Cleaning temperature dataV2.ipynb',
           'matrix_operations.py',
           'matrix_operations.pyc',
           'numpy_ex',
           'prime_numbers.py',
           'statistics.py',
           'tmean.csv',
           'udacity_quesries.sql',
           'Untitled.ipynb',
           'vector_operations.py',
           'vector_operations.pyc']
```

```
In [160]: data= pd.read_csv('tmean.csv')
```

```
In [162]: min_max_dates= data.iloc[:,range(3, 4021)].columns.max(), data.iloc[:,range(3, 4021)]
          print('Data starts and finish from {}'.format(min_max_dates))
```

```
Data starts and finish from ('9/9/14 0:00', '1/1/04 0:00')
```

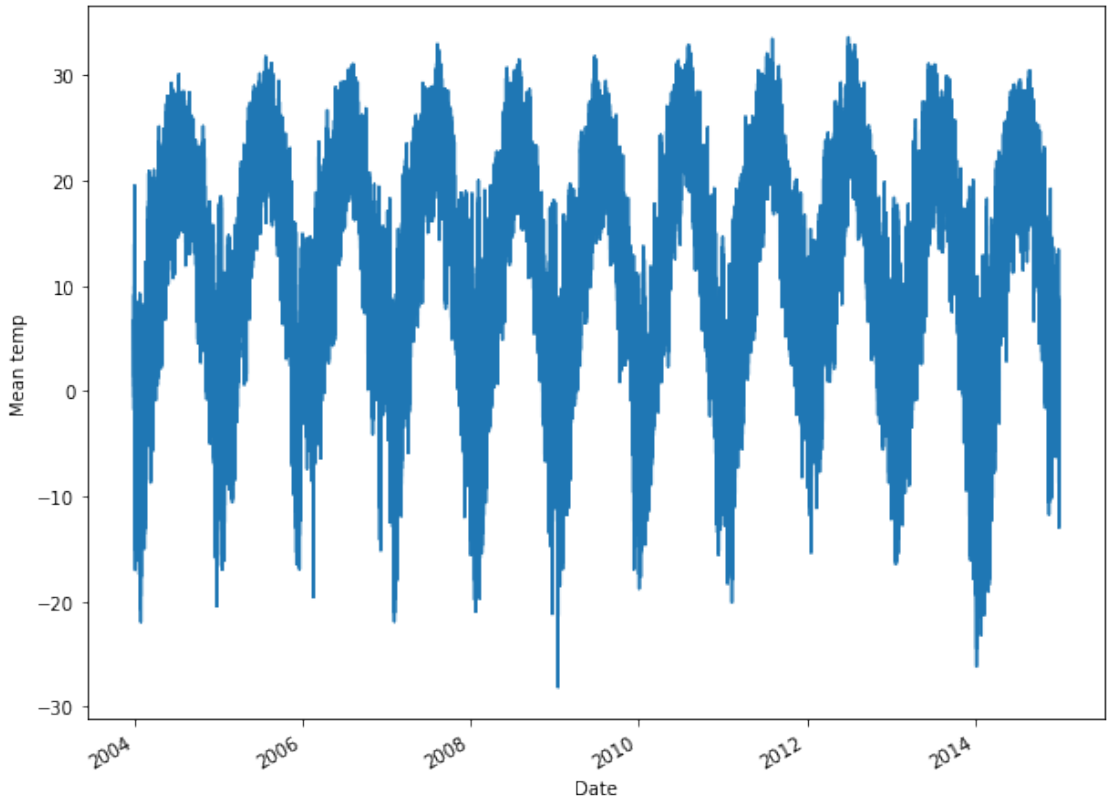
```
In [165]: ## MAke data long format
          data_long= pd.melt(data, id_vars= list(data.columns)[:3],
                             value_vars= list(data.columns)[3:],
                             var_name='Date',
```

```
                    value_name='Mean temp')
data_long['Date'] = pd.to_datetime(data_long['Date'])
data_long.head(10)
```

Out[165]:

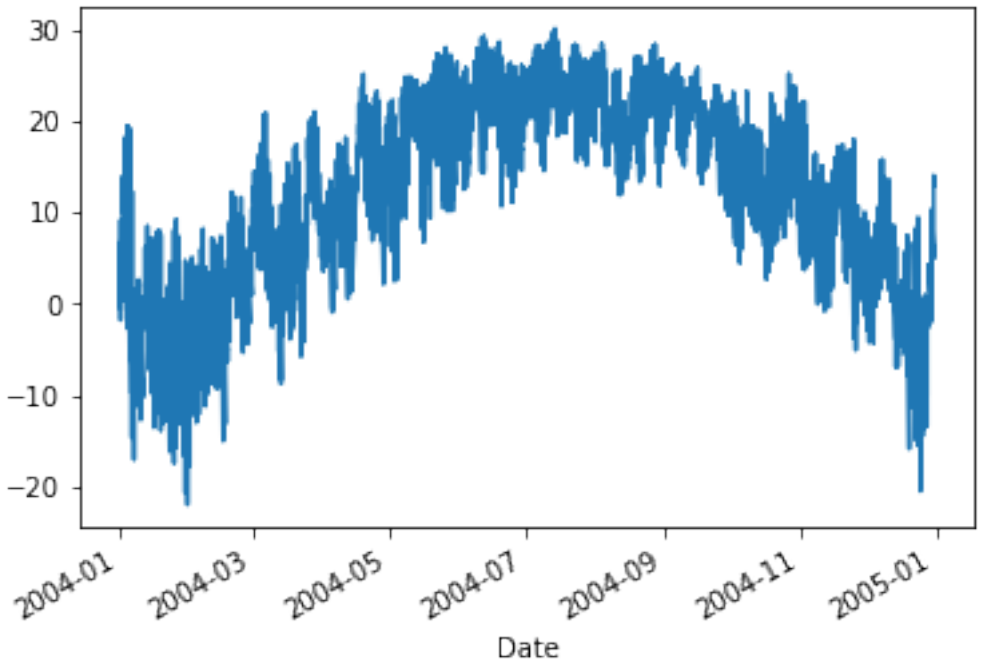
	Station_Name	Longitude	Latitude	Date	Mean temp
0	228	-85.125142	42.903843	2004-01-01	-0.455
1	1375	-84.629681	42.527093	2004-01-01	-0.120
2	1382	-84.736609	42.542085	2004-01-01	-0.045
3	1426	-84.640901	42.277745	2004-01-01	0.175
4	1436	-84.869903	42.300634	2004-01-01	0.425
5	1438	-85.013604	42.301348	2004-01-01	0.465
6	1472	-83.860508	42.041220	2004-01-01	0.685
7	1504	-85.240813	42.169341	2004-01-01	0.545
8	1519	-84.632883	42.185511	2004-01-01	0.265
9	1606	-85.244093	41.772676	2004-01-01	0.700

In [71]:
```
series= pd.Series(index=data_long.Date, data=data_long['Mean temp'].values)
import matplotlib.pyplot as plt
plt.figure(figsize=(10,8))
series.plot()
plt.xlabel('Date')
plt.ylabel('Mean temp')
plt.show()
```



In [106]:
```
## Pick only one year to try some time series:
from pandas import DatetimeIndex

#Lets add in a year column for easy slicing:
data_long['year']= pd.DatetimeIndex(data_long.Date.values).year

# Filter obs for year 2004 only:
data_2004 = data_long[data_long['year'] == 2004]

pd.Series(data=data_2004['Mean temp'].values, index=data_2004.Date).plot()
```

Out[106]: <matplotlib.axes._subplots.AxesSubplot at 0x2160a78fc88>



In [155]:
```
#### Here we try forecasting daily temperatures:
from sklearn.metrics import mean_squared_error
from time import clock

# Series for 2004 only:
series_2004= pd.Series(data=data_2004['Mean temp'].values, index=data_2004.Date)

# A function to run a n-window moving average to smooth the series and forecast
def moving_avg(input_series, window):
    '''
    This function runs a 3-step moving average to smooth a series
    inputs: input_series (a time indexed series),
```

```
            window (a integer to indicate the range for smoothing an entry)
        output= Accuracy measure, and a df with obs and predicted values
        '''
        # Prepare the memory process:
        history= [input_series[entry] for entry in range(window)]
        test= [input_series[entry] for entry in range(window, len(input_series))]
        predictions=[]

        # Implement the 3-window moving average:
        t0= clock()
        for step in range(len(test)):
            length= len(history)
            yhat= np.mean([history[period] for period in range(length-window, length)])
            obs= test[step]
            predictions.append(yhat)
            history.append(obs)
        error= mean_squared_error(test, predictions)
        print('running time for a {}-long series: {}'.format(len(test), clock()-t0))
        print('Test MSE: {:3f}'.format(error))

    moving_avg(series_2004.values, window=3)
```

```
running time for a 51603-long series: 0.6115410497200173
Test MSE: 2.644379
```

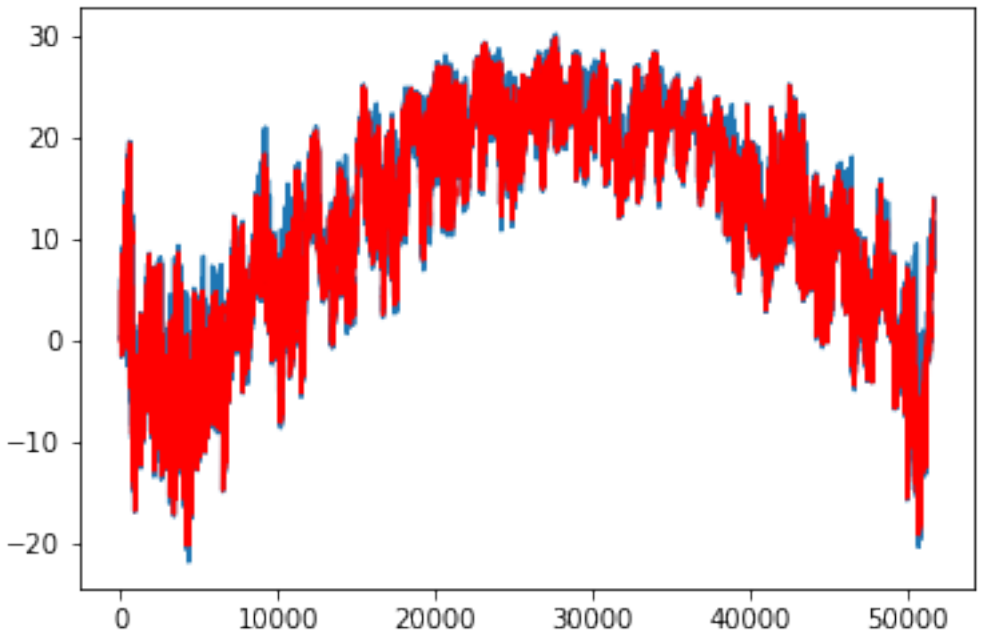
```
In [159]: data_2008 = data_long[data_long['year'] == 2008]
          series_2008= pd.Series(data=data_2008['Mean temp'].values, index=data_2008.Date)
          moving_avg(series_2008.values, window=3)
```

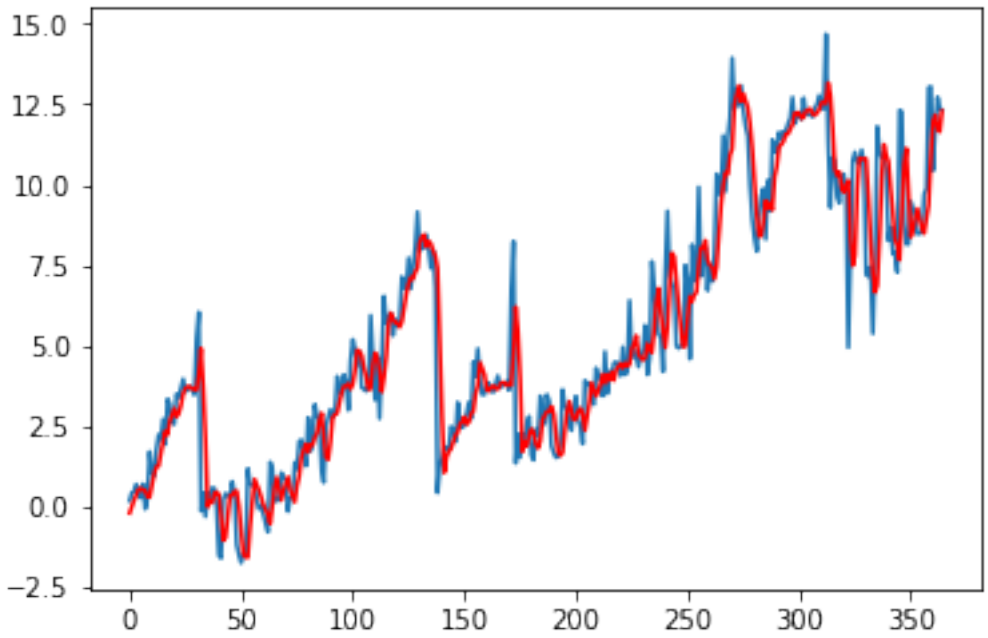
```
running time for a 51603-long series: 0.6243308408902521
Test MSE: 2.823440
```

```
In [ ]: ## Pre-code
        # Prepare the memory process:
        X= series_2004.values
        window= 3
        history= [X[i] for i in range(window)]
        test= [X[i] for i in range(window, len(X))]
        predictions=[]

        # Implement the 3-window moving average:

        for step in range(len(test)):
            length= len(history)
            yhat= np.mean([history[i] for i in range(length-window, length)])
            obs= test[step]
            predictions.append(yhat)
```

```
        history.append(obs)
    error= mean_squared_error(test, predictions)
    print('Test MSE: {:3f}'.format(error))
```

In [169]:
```
#PLots:
plt.plot(test)
plt.plot(predictions, color='red')
plt.show()
plt.plot(test[0:365])
plt.plot(predictions[0:365], color='red')
plt.show()
```





1.1 A digression on the advantages of list comprehensions vs. for-loops

A simple example that shows how efficient list comprehensions can be to fill in lists resulting from large iterations.

```
In [152]: import time
          t0=time.clock()
          test_list= [i for i in range(10000000)]
          print('A list of {} elements took {} seconds'.format(len(test_list), time.clock()-t0)

A list of 10000000 elements took 0.9539891227876751 seconds
```

```
In [153]: t0=time.clock()
          test_list=[]
          for i in range(10000000):
              test_list.append(i)
          print('A list of {} elements took {} seconds'.format(len(test_list), time.clock()-t0)

A list of 10000000 elements took 2.152322248198402 seconds
```