M02 _Xarxa_walkforward_normalitzat_multivariate

December 21, 2019

1 Xarxa neuronal

```
In [1]: import pandas as pd
        import numpy as np
        from pandas import datetime
        from matplotlib import pyplot as plt

        import keras
        from keras.models import Sequential
        from keras.layers import Dense
        from keras.layers import LSTM

        from keras.optimizers import SGD
        from sklearn.model_selection import StratifiedKFold
        from scipy.stats import uniform as sp_rand
        from scipy.stats import randint
        from time import time
        from sklearn import preprocessing
```

```
Using TensorFlow backend.
```

1.1 Consum diari total multivariate one-step

```
In [2]: daily=pd.read_csv('C:/Users/Laura/Desktop/Smart meters London/workspace R/Dades netes/
        daily.head(5)
```

```
Out[2]:          date  apparentTemperatureMax  sunsetTimeHour  weekday  season  \
        0  2013-01-16                   -0.15              16        3  winter
        1  2013-01-20                   -0.46              16        7  winter
        2  2013-01-10                    2.36              16        4  winter
        3  2013-01-06                    6.98              16        7  winter
        4  2012-01-31                    1.13              16        2  winter

           cloudCover  humidity  visibility  month  energy_sum
        0        0.48      0.91        4.12      1   13.147536
        1        0.85      0.91        5.10      1   15.021900
        2        0.70      0.94        5.21      1   12.066789
```

```
3         0.67       0.96         5.50       1    12.422263
4         0.55       0.84         5.62       1    13.890518
```

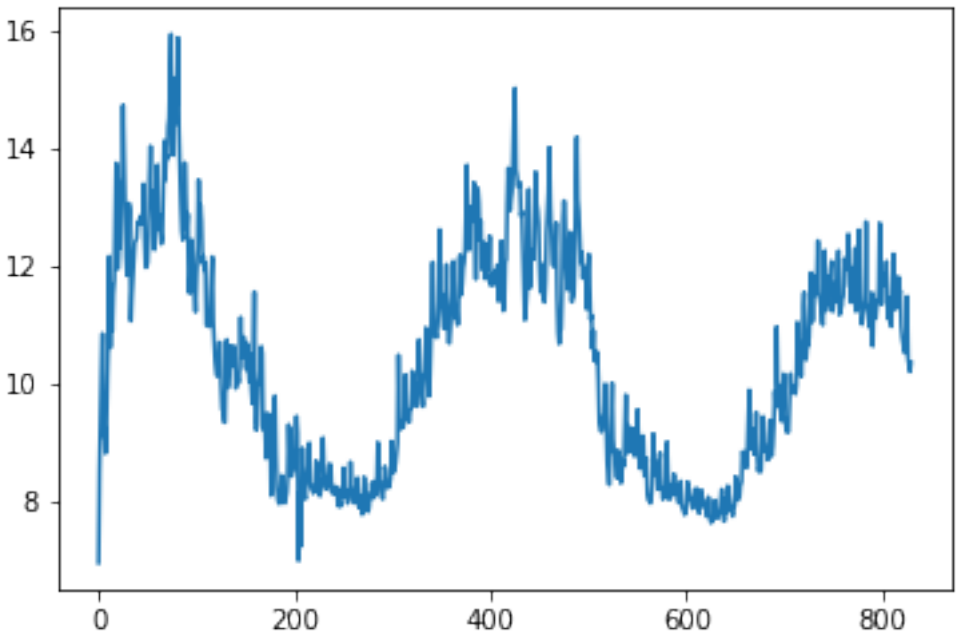
In [3]:
```
#Ens quedem amb date i energy_sum, ordenem valors per data i resetejem index
daily_dia=daily[['date','energy_sum','apparentTemperatureMax']].sort_values(by=['date']
daily_dia.head(5)
```

Out[3]:

	index	date	energy_sum	apparentTemperatureMax
0	677	2011-11-23	6.952692	10.36
1	691	2011-11-24	8.536480	12.93
2	713	2011-11-25	9.499781	13.03
3	728	2011-11-26	10.267707	12.96
4	729	2011-11-27	10.850805	13.54

In [16]:
```
plt.plot(daily_dia )
```

Out[16]:
```
[<matplotlib.lines.Line2D at 0x24f9e752240>]
```



In [4]:
```
daily_dia['t-1']=daily_dia['energy_sum'].shift(1)
daily_dia['t-2']=daily_dia['energy_sum'].shift(2)
daily_dia['t-3']=daily_dia['energy_sum'].shift(3)
daily_dia['t-4']=daily_dia['energy_sum'].shift(4)
daily_dia['t-5']=daily_dia['energy_sum'].shift(5)
daily_dia['t-6']=daily_dia['energy_sum'].shift(6)
daily_dia['t-7']=daily_dia['energy_sum'].shift(7)
daily_dia['t-8']=daily_dia['energy_sum'].shift(8)
```

```
daily_dia['temp(t-1)']=daily_dia['apparentTemperatureMax'].shift(1)
daily_dia['temp(t-2)']=daily_dia['apparentTemperatureMax'].shift(2)
daily_dia['temp(t-3)']=daily_dia['apparentTemperatureMax'].shift(3)
daily_dia['temp(t-4)']=daily_dia['apparentTemperatureMax'].shift(4)
daily_dia['temp(t-5)']=daily_dia['apparentTemperatureMax'].shift(5)
daily_dia['temp(t-6)']=daily_dia['apparentTemperatureMax'].shift(6)
daily_dia['temp(t-7)']=daily_dia['apparentTemperatureMax'].shift(7)
daily_dia['temp(t-8)']=daily_dia['apparentTemperatureMax'].shift(8)
```

```
daily_dia
```

Out[4]:

	index	date	energy_sum	apparentTemperatureMax	t-1	\
0	677	2011-11-23	6.952692	10.36	NaN	
1	691	2011-11-24	8.536480	12.93	6.952692	
2	713	2011-11-25	9.499781	13.03	8.536480	
3	728	2011-11-26	10.267707	12.96	9.499781	
4	729	2011-11-27	10.850805	13.54	10.267707	
5	704	2011-11-28	9.103382	12.58	10.850805	
6	718	2011-11-29	9.274873	13.47	9.103382	
7	727	2011-11-30	8.813513	11.87	9.274873	
8	778	2011-12-01	9.227707	12.15	8.813513	
9	773	2011-12-02	10.145910	5.33	9.227707	
10	791	2011-12-03	10.780273	11.42	10.145910	
11	822	2011-12-04	12.163127	6.66	10.780273	
12	807	2011-12-05	10.609714	3.13	12.163127	
13	813	2011-12-06	11.673417	3.77	10.609714	
14	810	2011-12-07	10.889362	5.14	11.673417	
15	788	2011-12-08	11.525150	12.89	10.889362	
16	797	2011-12-09	11.759837	3.99	11.525150	
17	799	2011-12-10	12.633801	3.14	11.759837	
18	776	2011-12-11	13.749174	5.72	12.633801	
19	775	2011-12-12	11.951958	5.94	13.749174	
20	786	2011-12-13	11.957446	12.08	11.951958	
21	818	2011-12-14	12.392776	2.88	11.957446	
22	795	2011-12-15	12.307079	4.38	12.392776	
23	763	2011-12-16	13.376080	0.99	12.307079	
24	770	2011-12-17	13.511968	1.72	13.376080	
25	808	2011-12-18	14.732271	1.98	13.511968	
26	757	2011-12-19	13.774471	4.02	14.732271	
27	803	2011-12-20	12.709106	4.98	13.774471	
28	748	2011-12-21	12.148570	12.14	12.709106	
29	806	2011-12-22	11.839403	12.14	12.148570	
..	...	...	...	...	...	
800	21	2014-01-29	11.800777	2.53	11.344805	
801	10	2014-01-30	11.685169	5.86	11.800777	
802	12	2014-01-31	11.857957	5.27	11.685169	

803	129	2014-02-01	11.710582		6.86	11.857957
804	155	2014-02-02	12.078164		6.48	11.710582
805	145	2014-02-03	11.280011		4.59	12.078164
806	134	2014-02-04	11.095584		5.63	11.280011
807	123	2014-02-05	11.415105		5.86	11.095584
808	118	2014-02-06	11.445403		7.34	11.415105
809	122	2014-02-07	10.972318		8.44	11.445403
810	126	2014-02-08	11.569300		5.67	10.972318
811	149	2014-02-09	12.202967		3.91	11.569300
812	132	2014-02-10	11.264175		7.07	12.202967
813	143	2014-02-11	11.452649		4.06	11.264175
814	131	2014-02-12	11.679099		4.73	11.452649
815	164	2014-02-13	11.285737		3.42	11.679099
816	125	2014-02-14	11.816914		12.02	11.285737
817	141	2014-02-15	11.490470		5.79	11.816914
818	151	2014-02-16	11.582159		7.88	11.490470
819	116	2014-02-17	10.979566		10.67	11.582159
820	128	2014-02-18	10.781898		10.13	10.979566
821	115	2014-02-19	10.674624		10.13	10.781898
822	121	2014-02-20	10.573835		12.50	10.674624
823	174	2014-02-21	10.518126		10.15	10.573835
824	167	2014-02-22	10.776242		11.63	10.518126
825	139	2014-02-23	11.480411		11.94	10.776242
826	162	2014-02-24	10.411403		14.23	11.480411
827	136	2014-02-25	10.294997		11.43	10.411403
828	161	2014-02-26	10.202945		11.29	10.294997
829	133	2014-02-27	10.356350		10.31	10.202945

	t-2	t-3	t-4	t-5	t-6	t-7	\
0	NaN	NaN	NaN	NaN	NaN	NaN	
1	NaN	NaN	NaN	NaN	NaN	NaN	
2	6.952692	NaN	NaN	NaN	NaN	NaN	
3	8.536480	6.952692	NaN	NaN	NaN	NaN	
4	9.499781	8.536480	6.952692	NaN	NaN	NaN	
5	10.267707	9.499781	8.536480	6.952692	NaN	NaN	
6	10.850805	10.267707	9.499781	8.536480	6.952692	NaN	
7	9.103382	10.850805	10.267707	9.499781	8.536480	6.952692	
8	9.274873	9.103382	10.850805	10.267707	9.499781	8.536480	
9	8.813513	9.274873	9.103382	10.850805	10.267707	9.499781	
10	9.227707	8.813513	9.274873	9.103382	10.850805	10.267707	
11	10.145910	9.227707	8.813513	9.274873	9.103382	10.850805	
12	10.780273	10.145910	9.227707	8.813513	9.274873	9.103382	
13	12.163127	10.780273	10.145910	9.227707	8.813513	9.274873	
14	10.609714	12.163127	10.780273	10.145910	9.227707	8.813513	
15	11.673417	10.609714	12.163127	10.780273	10.145910	9.227707	
16	10.889362	11.673417	10.609714	12.163127	10.780273	10.145910	
17	11.525150	10.889362	11.673417	10.609714	12.163127	10.780273	
18	11.759837	11.525150	10.889362	11.673417	10.609714	12.163127	

```
19   12.633801  11.759837  11.525150  10.889362  11.673417  10.609714
20   13.749174  12.633801  11.759837  11.525150  10.889362  11.673417
21   11.951958  13.749174  12.633801  11.759837  11.525150  10.889362
22   11.957446  11.951958  13.749174  12.633801  11.759837  11.525150
23   12.392776  11.957446  11.951958  13.749174  12.633801  11.759837
24   12.307079  12.392776  11.957446  11.951958  13.749174  12.633801
25   13.376080  12.307079  12.392776  11.957446  11.951958  13.749174
26   13.511968  13.376080  12.307079  12.392776  11.957446  11.951958
27   14.732271  13.511968  13.376080  12.307079  12.392776  11.957446
28   13.774471  14.732271  13.511968  13.376080  12.307079  12.392776
29   12.709106  13.774471  14.732271  13.511968  13.376080  12.307079
..         ...        ...        ...        ...        ...        ...
800  11.753871  12.729659  11.620778  11.409880  11.300414  11.109560
801  11.344805  11.753871  12.729659  11.620778  11.409880  11.300414
802  11.800777  11.344805  11.753871  12.729659  11.620778  11.409880
803  11.685169  11.800777  11.344805  11.753871  12.729659  11.620778
804  11.857957  11.685169  11.800777  11.344805  11.753871  12.729659
805  11.710582  11.857957  11.685169  11.800777  11.344805  11.753871
806  12.078164  11.710582  11.857957  11.685169  11.800777  11.344805
807  11.280011  12.078164  11.710582  11.857957  11.685169  11.800777
808  11.095584  11.280011  12.078164  11.710582  11.857957  11.685169
809  11.415105  11.095584  11.280011  12.078164  11.710582  11.857957
810  11.445403  11.415105  11.095584  11.280011  12.078164  11.710582
811  10.972318  11.445403  11.415105  11.095584  11.280011  12.078164
812  11.569300  10.972318  11.445403  11.415105  11.095584  11.280011
813  12.202967  11.569300  10.972318  11.445403  11.415105  11.095584
814  11.264175  12.202967  11.569300  10.972318  11.445403  11.415105
815  11.452649  11.264175  12.202967  11.569300  10.972318  11.445403
816  11.679099  11.452649  11.264175  12.202967  11.569300  10.972318
817  11.285737  11.679099  11.452649  11.264175  12.202967  11.569300
818  11.816914  11.285737  11.679099  11.452649  11.264175  12.202967
819  11.490470  11.816914  11.285737  11.679099  11.452649  11.264175
820  11.582159  11.490470  11.816914  11.285737  11.679099  11.452649
821  10.979566  11.582159  11.490470  11.816914  11.285737  11.679099
822  10.781898  10.979566  11.582159  11.490470  11.816914  11.285737
823  10.674624  10.781898  10.979566  11.582159  11.490470  11.816914
824  10.573835  10.674624  10.781898  10.979566  11.582159  11.490470
825  10.518126  10.573835  10.674624  10.781898  10.979566  11.582159
826  10.776242  10.518126  10.573835  10.674624  10.781898  10.979566
827  11.480411  10.776242  10.518126  10.573835  10.674624  10.781898
828  10.411403  11.480411  10.776242  10.518126  10.573835  10.674624
829  10.294997  10.411403  11.480411  10.776242  10.518126  10.573835

          t-8  temp(t-1)  temp(t-2)  temp(t-3)  temp(t-4)  temp(t-5)  \
0         NaN        NaN        NaN        NaN        NaN        NaN
1         NaN      10.36        NaN        NaN        NaN        NaN
2         NaN      12.93      10.36        NaN        NaN        NaN
3         NaN      13.03      12.93      10.36        NaN        NaN
```

4	NaN	12.96	13.03	12.93	10.36	NaN
5	NaN	13.54	12.96	13.03	12.93	10.36
6	NaN	12.58	13.54	12.96	13.03	12.93
7	NaN	13.47	12.58	13.54	12.96	13.03
8	6.952692	11.87	13.47	12.58	13.54	12.96
9	8.536480	12.15	11.87	13.47	12.58	13.54
10	9.499781	5.33	12.15	11.87	13.47	12.58
11	10.267707	11.42	5.33	12.15	11.87	13.47
12	10.850805	6.66	11.42	5.33	12.15	11.87
13	9.103382	3.13	6.66	11.42	5.33	12.15
14	9.274873	3.77	3.13	6.66	11.42	5.33
15	8.813513	5.14	3.77	3.13	6.66	11.42
16	9.227707	12.89	5.14	3.77	3.13	6.66
17	10.145910	3.99	12.89	5.14	3.77	3.13
18	10.780273	3.14	3.99	12.89	5.14	3.77
19	12.163127	5.72	3.14	3.99	12.89	5.14
20	10.609714	5.94	5.72	3.14	3.99	12.89
21	11.673417	12.08	5.94	5.72	3.14	3.99
22	10.889362	2.88	12.08	5.94	5.72	3.14
23	11.525150	4.38	2.88	12.08	5.94	5.72
24	11.759837	0.99	4.38	2.88	12.08	5.94
25	12.633801	1.72	0.99	4.38	2.88	12.08
26	13.749174	1.98	1.72	0.99	4.38	2.88
27	11.951958	4.02	1.98	1.72	0.99	4.38
28	11.957446	4.98	4.02	1.98	1.72	0.99
29	12.392776	12.14	4.98	4.02	1.98	1.72
..	...	...	...	...	...	...
800	11.370601	6.34	4.34	5.99	11.77	5.72
801	11.109560	2.53	6.34	4.34	5.99	11.77
802	11.300414	5.86	2.53	6.34	4.34	5.99
803	11.409880	5.27	5.86	2.53	6.34	4.34
804	11.620778	6.86	5.27	5.86	2.53	6.34
805	12.729659	6.48	6.86	5.27	5.86	2.53
806	11.753871	4.59	6.48	6.86	5.27	5.86
807	11.344805	5.63	4.59	6.48	6.86	5.27
808	11.800777	5.86	5.63	4.59	6.48	6.86
809	11.685169	7.34	5.86	5.63	4.59	6.48
810	11.857957	8.44	7.34	5.86	5.63	4.59
811	11.710582	5.67	8.44	7.34	5.86	5.63
812	12.078164	3.91	5.67	8.44	7.34	5.86
813	11.280011	7.07	3.91	5.67	8.44	7.34
814	11.095584	4.06	7.07	3.91	5.67	8.44
815	11.415105	4.73	4.06	7.07	3.91	5.67
816	11.445403	3.42	4.73	4.06	7.07	3.91
817	10.972318	12.02	3.42	4.73	4.06	7.07
818	11.569300	5.79	12.02	3.42	4.73	4.06
819	12.202967	7.88	5.79	12.02	3.42	4.73
820	11.264175	10.67	7.88	5.79	12.02	3.42

821	11.452649	10.13	10.67	7.88	5.79	12.02
822	11.679099	10.13	10.13	10.67	7.88	5.79
823	11.285737	12.50	10.13	10.13	10.67	7.88
824	11.816914	10.15	12.50	10.13	10.13	10.67
825	11.490470	11.63	10.15	12.50	10.13	10.13
826	11.582159	11.94	11.63	10.15	12.50	10.13
827	10.979566	14.23	11.94	11.63	10.15	12.50
828	10.781898	11.43	14.23	11.94	11.63	10.15
829	10.674624	11.29	11.43	14.23	11.94	11.63

	temp(t-6)	temp(t-7)	temp(t-8)
0	NaN	NaN	NaN
1	NaN	NaN	NaN
2	NaN	NaN	NaN
3	NaN	NaN	NaN
4	NaN	NaN	NaN
5	NaN	NaN	NaN
6	10.36	NaN	NaN
7	12.93	10.36	NaN
8	13.03	12.93	10.36
9	12.96	13.03	12.93
10	13.54	12.96	13.03
11	12.58	13.54	12.96
12	13.47	12.58	13.54
13	11.87	13.47	12.58
14	12.15	11.87	13.47
15	5.33	12.15	11.87
16	11.42	5.33	12.15
17	6.66	11.42	5.33
18	3.13	6.66	11.42
19	3.77	3.13	6.66
20	5.14	3.77	3.13
21	12.89	5.14	3.77
22	3.99	12.89	5.14
23	3.14	3.99	12.89
24	5.72	3.14	3.99
25	5.94	5.72	3.14
26	12.08	5.94	5.72
27	2.88	12.08	5.94
28	4.38	2.88	12.08
29	0.99	4.38	2.88
..	...	...	...
800	4.93	10.02	6.26
801	5.72	4.93	10.02
802	11.77	5.72	4.93
803	5.99	11.77	5.72
804	4.34	5.99	11.77
805	6.34	4.34	5.99

```
806       2.53       6.34       4.34
807       5.86       2.53       6.34
808       5.27       5.86       2.53
809       6.86       5.27       5.86
810       6.48       6.86       5.27
811       4.59       6.48       6.86
812       5.63       4.59       6.48
813       5.86       5.63       4.59
814       7.34       5.86       5.63
815       8.44       7.34       5.86
816       5.67       8.44       7.34
817       3.91       5.67       8.44
818       7.07       3.91       5.67
819       4.06       7.07       3.91
820       4.73       4.06       7.07
821       3.42       4.73       4.06
822      12.02       3.42       4.73
823       5.79      12.02       3.42
824       7.88       5.79      12.02
825      10.67       7.88       5.79
826      10.13      10.67       7.88
827      10.13      10.13      10.67
828      12.50      10.13      10.13
829      10.15      12.50      10.13

[830 rows x 20 columns]
```

In [5]:
```
#Ens quedem amb energies i temperatures
#No agafem apparent temperature max ja que quan fem la predicció representa que no ho
daily_dia=daily_dia[['energy_sum','t-1','t-2','t-3','t-4','t-5','t-6','t-7','t-8','temp
daily_dia.head(5)
```

Out[5]:
```
   energy_sum        t-1       t-2       t-3       t-4  t-5  t-6  t-7  t-8  \
0    6.952692        NaN       NaN       NaN       NaN  NaN  NaN  NaN  NaN
1    8.536480   6.952692       NaN       NaN       NaN  NaN  NaN  NaN  NaN
2    9.499781   8.536480  6.952692       NaN       NaN  NaN  NaN  NaN  NaN
3   10.267707   9.499781  8.536480  6.952692       NaN  NaN  NaN  NaN  NaN
4   10.850805  10.267707  9.499781  8.536480  6.952692  NaN  NaN  NaN  NaN

   temp(t-1)  temp(t-2)  temp(t-3)  temp(t-4)  temp(t-5)  temp(t-6)  \
0        NaN        NaN        NaN        NaN        NaN        NaN
1      10.36        NaN        NaN        NaN        NaN        NaN
2      12.93      10.36        NaN        NaN        NaN        NaN
3      13.03      12.93      10.36        NaN        NaN        NaN
4      12.96      13.03      12.93      10.36        NaN        NaN

   temp(t-7)  temp(t-8)
0        NaN        NaN
```

```
1         NaN         NaN
2         NaN         NaN
3         NaN         NaN
4         NaN         NaN
```

In [6]:
```
#Eliminem les 8 primeres files ja que contenen NaN (valors buits)

daily_dia=daily_dia.drop([0,1,2,3,4,5,6,7])
daily_dia.head(5)
```

Out[6]:

	energy_sum	t-1	t-2	t-3	t-4	t-5	t-6	t-7	t-8	temp(t-1)	temp(t-2)	temp(t-3)	temp(t-4)	temp(t-5)	temp(t-6)	temp(t-7)	temp(t-8)
8	9.227707	8.813513	9.274873	9.103382	10.850805	10.267707	9.499781	8.536480	6.952692	11.87	13.47	12.58	13.54	12.96	13.03	12.93	10.36
9	10.145910	9.227707	8.813513	9.274873	9.103382	10.850805	10.267707	9.499781	8.536480	12.15	11.87	13.47	12.58	13.54	12.96	13.03	12.93
10	10.780273	10.145910	9.227707	8.813513	9.274873	9.103382	10.850805	10.267707	9.499781	5.33	12.15	11.87	13.47	12.58	13.54	12.96	13.03
11	12.163127	10.780273	10.145910	9.227707	8.813513	9.274873	9.103382	10.850805	10.267707	11.42	5.33	12.15	11.87	13.47	12.58	13.54	12.96
12	10.609714	12.163127	10.780273	10.145910	9.227707	8.813513	9.274873	9.103382	10.850805	6.66	11.42	5.33	12.15	11.87	13.47	12.58	13.54

In [7]:
```
len(daily_dia)
```

Out[7]:
```
822
```

In [8]:
```
#normalitzem
scaler=preprocessing.MinMaxScaler(feature_range=(0, 1))
daily_dia_norm=scaler.fit_transform(daily_dia)

#daily_dia_norm[:,0]
print(daily_dia_norm)
#daily_dia_norm[:,1:]
```

```
[[0.250036   0.20375985 0.25530572 ... 0.46920339 0.46646592 0.39611278]
 [0.35262316 0.250036   0.20375985 ... 0.46728716 0.46920339 0.46646592]
 [0.42349794 0.35262316 0.250036   ... 0.48316452 0.46728716 0.46920339]
 ...
 [0.36928    0.38228562 0.50172153 ... 0.38981659 0.38981659 0.40459896]
 [0.35899548 0.36928    0.38228562 ... 0.45469477 0.38981659 0.38981659]
```

```
 [0.37613476 0.35899548 0.36928    ... 0.39036408 0.45469477 0.38981659]]
```

```
In [47]: X_daily[0]
```

```
Out[47]: array([0.25530572, 0.2361457 , 0.43137821, 0.36623108, 0.28043381,
                0.17280805, 0.        , 0.48124829, 0.45688475, 0.48316452,
                0.46728716, 0.46920339, 0.46646592, 0.39611278])
```

```
In [9]: #Seleccionem dades per test i train
        y_daily=daily_dia_norm[:,0]
        X_daily=daily_dia_norm[:,1:17]

        #y_daily=daily_dia['energy_sum']
        #X_daily=daily_dia.drop(['energy_sum'], axis='columns')



        #Reshape de [samples,timesteps] a [samples,timesteps,features]

        #Enlloc de 14 features en son 7 de una feature i 7 duna altre
        X_daily=np.reshape(X_daily, (X_daily.shape[0], 8,2))
```

```
In [10]: # definim model
         import tensorflow as tf
         model =Sequential()
         model.add(LSTM(50, activation='relu', input_shape=(8, 2)))
         model.add(Dense(1))
         model.compile(optimizer='adam', loss='mse', metrics=['accuracy'])
```

```
WARNING:tensorflow:From c:\users\laura\appdata\local\programs\python\python37\lib\site-packages
Instructions for updating:
Colocations handled automatically by placer.
```

```
In [11]: import math
         from sklearn.metrics import mean_squared_error

         #Walk forward per test i train
         minim=100
         n_train=465
         lenght=len(daily_dia)

         llista_evaluate=list()
         llista_prediccions=list()
         llista_preditrain=list()
         llista_scores=list()
         llista_scoretrain=list()
         sumScores=0
```

```
        for i in range(n_train,lenght):
            minim=minim+1
            X_train,X_test= X_daily[minim:i],X_daily[i:i+1]
            y_train,y_test= y_daily[minim:i],y_daily[i:i+1]

            #fem fit al model
            model.fit(X_train, y_train, epochs=50, verbose=0)

            #mostrem score per cada model
            score=model.evaluate(X_test,y_test,verbose=0)
            llista_evaluate.append(score)

            #Predim per cadascun
            preditest=model.predict(X_test)
            llista_prediccions.append(preditest)

            preditrain=model.predict(X_train)
            llista_preditrain.append(preditrain)

            trainScore = math.sqrt(mean_squared_error(y_train, preditrain))
            llista_scoretrain.append(trainScore )


            testScore = math.sqrt(mean_squared_error(y_test, preditest))
            llista_scores.append(testScore)

            sumScores=sumScores+testScore
```

```
WARNING:tensorflow:From c:\users\laura\appdata\local\programs\python\python37\lib\site-packages
Instructions for updating:
Use tf.cast instead.
```

```
In [53]: #Dividim la suma de scores de test entre el nombre de prediccions per obtenir la mitj
         sumScores/(lenght-n_train)
```

```
Out[53]: 0.036842092976021465
```

```
In [66]: sumScores/len(listpredi)
```

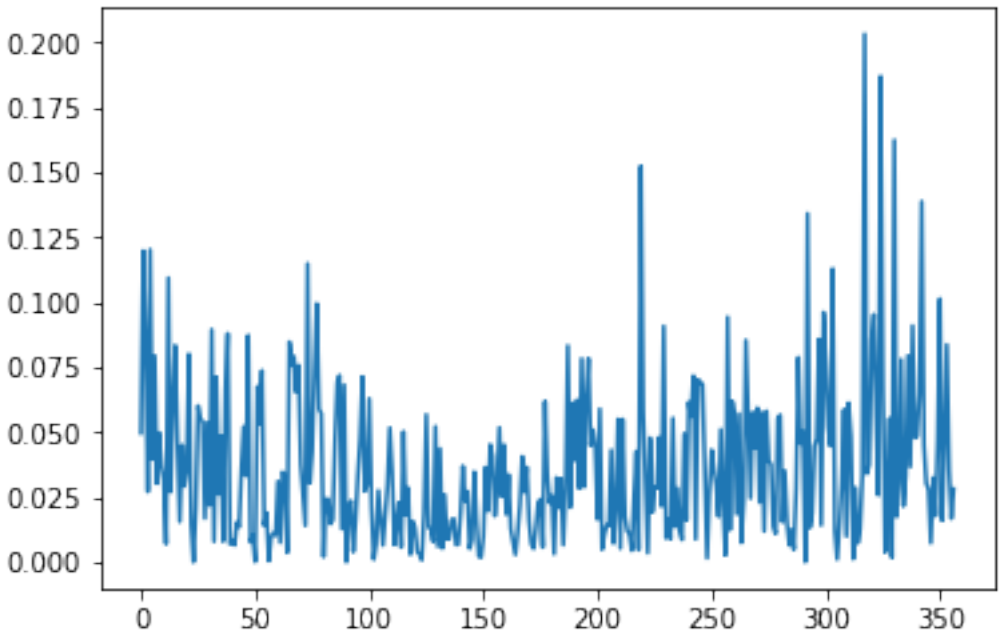
```
Out[66]: 0.036842092976021465
```

```
In [68]: print(model.metrics_names)
```

```
['loss', 'acc']
```

```
In [59]: plt.plot(llista_scores)
```

Out[59]: [<matplotlib.lines.Line2D at 0x210feb03898>]



In [ ]:

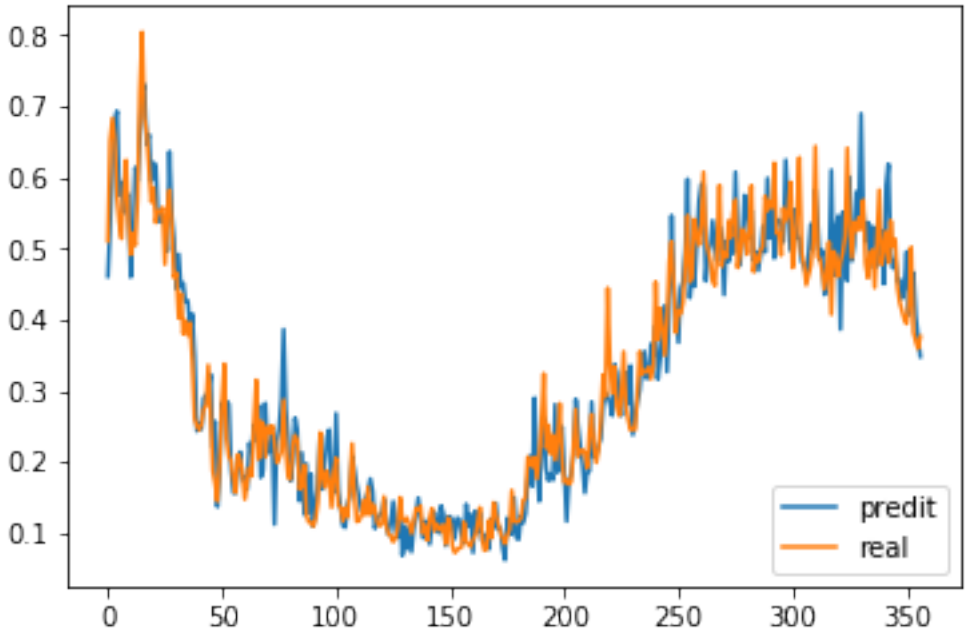
In [14]:
```
predis=list()

for i in range(len(llista_prediccions)):
    predi=llista_prediccions[i].tolist()
    predis.append(predi)

predis=np.reshape(predis, (357)  )

predis
```

Out[14]:
```
array([0.46085009, 0.53195691, 0.59825253, 0.68217349, 0.69342124,
       0.57553029, 0.5935061 , 0.55025238, 0.57454509, 0.57619506,
       0.45969853, 0.5292812 , 0.61381954, 0.59481907, 0.65893263,
       0.72126961, 0.73082519, 0.64654744, 0.66026759, 0.59480816,
       0.62077057, 0.61666107, 0.53775054, 0.55210423, 0.53695619,
       0.53798634, 0.49620968, 0.63660848, 0.54668939, 0.51269543,
       0.44384259, 0.4921385 , 0.44494465, 0.45125276, 0.4250561 ,
       0.42657471, 0.3875967 , 0.40787923, 0.34827465, 0.24323215,
       0.25302354, 0.24590921, 0.29008964, 0.29254162, 0.30004275,
       0.32274878, 0.22045609, 0.25671917, 0.13658869, 0.18956566,
       0.28308117, 0.26986459, 0.28494608, 0.28095829, 0.18739031,
       0.15616195, 0.15610532, 0.20004138, 0.21367544, 0.17459342,
```

0.17834769, 0.16153166, 0.22600067, 0.21356571, 0.25172818,
0.23015893, 0.27986604, 0.17786652, 0.18779933, 0.28232181,
0.21208081, 0.21485993, 0.23658533, 0.11186726, 0.22881067,
0.24766654, 0.28773758, 0.38639536, 0.27423066, 0.23538253,
0.17292225, 0.19982389, 0.26149929, 0.24504127, 0.14484641,
0.21251664, 0.12604237, 0.19735295, 0.12779951, 0.1824587 ,
0.1090247 , 0.14129725, 0.16663992, 0.23697135, 0.16126239,
0.19751722, 0.23472074, 0.24496631, 0.16307765, 0.15593161,
0.26808146, 0.15869936, 0.13474932, 0.10942796, 0.10754447,
0.13934474, 0.15247327, 0.20789246, 0.18970646, 0.16762687,
0.1515674 , 0.13117447, 0.12994987, 0.1479177 , 0.15873691,
0.17604882, 0.15874287, 0.10602392, 0.11750112, 0.12529407,
0.1260069 , 0.1467385 , 0.11251688, 0.0968898 , 0.11446655,
0.1440805 , 0.10575226, 0.09352605, 0.14174378, 0.06806809,
0.10941784, 0.07730041, 0.10749334, 0.07307933, 0.10542613,
0.12550946, 0.14918178, 0.12090802, 0.09266201, 0.11687058,
0.1085849 , 0.08405167, 0.11069445, 0.12978655, 0.11814374,
0.09971824, 0.13798106, 0.12649515, 0.0816781 , 0.12291934,
0.12288383, 0.11742289, 0.09164251, 0.12099133, 0.1194756 ,
0.09757482, 0.08556155, 0.14038062, 0.10870832, 0.12573482,
0.07209659, 0.13046399, 0.10082746, 0.12773831, 0.08859462,
0.08631203, 0.09929159, 0.0770894 , 0.11980586, 0.1056841 ,
0.14174503, 0.10596839, 0.10586184, 0.07856441, 0.06176443,
0.12087047, 0.11021381, 0.09785564, 0.14949127, 0.09232625,
0.09066661, 0.12404196, 0.1139628 , 0.12693271, 0.17450196,
0.20769835, 0.16535307, 0.28991252, 0.1972138 , 0.14437976,
0.21796331, 0.26160559, 0.19088972, 0.17337954, 0.18212339,
0.17415878, 0.2806749 , 0.18483448, 0.23094603, 0.24898341,
0.18724485, 0.11625762, 0.17306979, 0.18237498, 0.20995328,
0.28788725, 0.25052544, 0.22284175, 0.19557461, 0.15625358,
0.18604693, 0.18659717, 0.2842918 , 0.20672452, 0.20962366,
0.22256437, 0.23253702, 0.27952942, 0.29607332, 0.2920379 ,
0.28167003, 0.26480588, 0.33692634, 0.32507628, 0.28410167,
0.26491195, 0.32638115, 0.32544938, 0.28100297, 0.33525574,
0.23782894, 0.26176921, 0.28443557, 0.29956496, 0.33674595,
0.35523292, 0.31664503, 0.32426965, 0.36594763, 0.35003546,
0.39140058, 0.31620353, 0.34396929, 0.38085651, 0.41988295,
0.3264496 , 0.41381109, 0.54643726, 0.45057848, 0.40897617,
0.36789387, 0.44404244, 0.45380437, 0.49869251, 0.59765822,
0.43061143, 0.46145371, 0.44688082, 0.50644404, 0.56693125,
0.59066272, 0.58895123, 0.45428407, 0.48997068, 0.50537479,
0.53940779, 0.50098002, 0.48264807, 0.53140885, 0.51865488,
0.43490461, 0.51088828, 0.48160696, 0.52762997, 0.49313605,
0.60768819, 0.51076961, 0.4766359 , 0.51608545, 0.57499653,
0.54848301, 0.51485586, 0.5533579 , 0.48247564, 0.4960584 ,
0.46896282, 0.49273619, 0.53125739, 0.4948459 , 0.59895986,
0.51470107, 0.55755138, 0.48630536, 0.53462493, 0.54072434,
0.53499371, 0.50931495, 0.62471718, 0.56444412, 0.49745327,

```
0.54938728, 0.55483735, 0.51443827, 0.51513612, 0.48172978,
0.47681195, 0.46316534, 0.49225408, 0.53438795, 0.49822861,
0.58253014, 0.53703815, 0.48398858, 0.49743167, 0.43505326,
0.45090792, 0.4758442 , 0.61044574, 0.46207792, 0.52703351,
0.54600912, 0.38630357, 0.55108428, 0.49155164, 0.45438111,
0.60053527, 0.48263288, 0.50469762, 0.5799759 , 0.54206264,
0.68978816, 0.55100197, 0.50997245, 0.53674525, 0.47281849,
0.53118455, 0.5244388 , 0.47488239, 0.49147928, 0.52545285,
0.4502126 , 0.58857542, 0.61873007, 0.49416113, 0.47246623,
0.48505291, 0.45323026, 0.45620453, 0.42956594, 0.44696513,
0.49554926, 0.4069531 , 0.45641488, 0.46597323, 0.40472919,
0.37585163, 0.34792179])
```

In [15]:
```
##Mostrem
plt.plot(predis, label="predit")
plt.plot(y_daily[n_train:lenght], label="real")
plt.legend(loc="lower right")
plt.show()
```



In [54]:
```
#Creem un dataset amb format (nombre prediccions,17) per tornar les prediccions i els
#El necessitem d'questa mida encara que només volguem passar 2 variables ja que al fe
#per fer la inversa necessitem 17 variables
#Com que només en tenim 2, les ajuntem al dataset inicial i ens quedem amb 15 variabl
#Obtenint un dataset amb 15 variables aleatories i les 2 variables que ens interessen

prova=daily_dia.iloc[n_train:lenght]
```

```
prova
#len(predis)
#lenght-n_train
prova['predi']=predis
prova['y']=y_daily[n_train:lenght]
prova=prova.drop(['energy_sum','t-1'], axis=1)
prova

prova=prova[['predi','y','t-2','t-3','t-4','t-5','t-6','t-7','t-8','temp(t-1)','temp(t
prova
```

```
c:\users\laura\appdata\local\programs\python\python37\lib\site-packages\ipykernel_launcher.py:1
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  # This is added back by InteractiveShellApp.init_path()
c:\users\laura\appdata\local\programs\python\python37\lib\site-packages\ipykernel_launcher.py:1
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  if sys.path[0] == '':
```

Out[54]:

	predi	y	t-2	t-3	t-4	t-5	\
473	0.460850	0.510600	10.889469	10.675248	10.860481	11.481859	
474	0.531957	0.651732	10.930170	10.889469	10.675248	10.860481	
475	0.598253	0.683428	11.559878	10.930170	10.889469	10.675248	
476	0.682173	0.654997	12.823073	11.559878	10.930170	10.889469	
477	0.693421	0.573173	13.106773	12.823073	11.559878	10.930170	
478	0.575530	0.535873	12.852295	13.106773	12.823073	11.559878	
479	0.593506	0.514061	12.119938	12.852295	13.106773	12.823073	
480	0.550252	0.580609	11.786082	12.119938	12.852295	13.106773	
481	0.574545	0.624326	11.590859	11.786082	12.119938	12.852295	
482	0.576195	0.539280	12.186487	11.590859	11.786082	12.119938	
483	0.459699	0.491355	12.577783	12.186487	11.590859	11.786082	
484	0.529281	0.522145	11.816573	12.577783	12.186487	11.590859	
485	0.613820	0.504442	11.387627	11.816573	12.577783	12.186487	
486	0.594819	0.567725	11.663214	11.387627	11.816573	12.577783	
487	0.658933	0.719460	11.504756	11.663214	11.387627	11.816573	
488	0.721270	0.804631	12.071173	11.504756	11.663214	11.387627	
489	0.730825	0.684716	13.429271	12.071173	11.504756	11.663214	
490	0.646547	0.662177	14.191591	13.429271	12.071173	11.504756	
491	0.660268	0.615194	13.118295	14.191591	13.429271	12.071173	
492	0.594808	0.565466	12.916559	13.118295	14.191591	13.429271	
493	0.620771	0.585646	12.496044	12.916559	13.118295	14.191591	
494	0.616661	0.536523	12.050954	12.496044	12.916559	13.118295	

```
495  0.537751  0.552256  12.231576  12.050954  12.496044  12.916559
496  0.552104  0.552256  11.791904  12.231576  12.050954  12.496044
497  0.536956  0.557809  11.932721  11.791904  12.231576  12.050954
498  0.537986  0.477794  11.932721  11.932721  11.791904  12.231576
499  0.496210  0.551195  11.982423  11.932721  11.932721  11.791904
500  0.636608  0.582339  11.266252  11.982423  11.932721  11.932721
501  0.546689  0.529772  11.923226  11.266252  11.982423  11.932721
502  0.512695  0.458904  12.201972  11.923226  11.266252  11.982423
..        ...       ...        ...        ...        ...        ...
800  0.504698  0.537515  11.753871  12.729659  11.620778  11.409880
801  0.579976  0.524598  11.344805  11.753871  12.729659  11.620778
802  0.542063  0.543903  11.800777  11.344805  11.753871  12.729659
803  0.689788  0.527438  11.685169  11.800777  11.344805  11.753871
804  0.551002  0.568506  11.857957  11.685169  11.800777  11.344805
805  0.509972  0.479332  11.710582  11.857957  11.685169  11.800777
806  0.536745  0.458726  12.078164  11.710582  11.857957  11.685169
807  0.472818  0.494425  11.280011  12.078164  11.710582  11.857957
808  0.531185  0.497810  11.095584  11.280011  12.078164  11.710582
809  0.524439  0.444954  11.415105  11.095584  11.280011  12.078164
810  0.474882  0.511653  11.445403  11.415105  11.095584  11.280011
811  0.491479  0.582450  10.972318  11.445403  11.415105  11.095584
812  0.525453  0.477562  11.569300  10.972318  11.445403  11.415105
813  0.450213  0.498620  12.202967  11.569300  10.972318  11.445403
814  0.588575  0.523920  11.264175  12.202967  11.569300  10.972318
815  0.618730  0.479971  11.452649  11.264175  12.202967  11.569300
816  0.494161  0.539318  11.679099  11.452649  11.264175  12.202967
817  0.472466  0.502845  11.285737  11.679099  11.452649  11.264175
818  0.485053  0.513089  11.816914  11.285737  11.679099  11.452649
819  0.453230  0.445764  11.490470  11.816914  11.285737  11.679099
820  0.456205  0.423680  11.582159  11.490470  11.816914  11.285737
821  0.429566  0.411694  10.979566  11.582159  11.490470  11.816914
822  0.446965  0.400434  10.781898  10.979566  11.582159  11.490470
823  0.495549  0.394209  10.674624  10.781898  10.979566  11.582159
824  0.406953  0.423048  10.573835  10.674624  10.781898  10.979566
825  0.456415  0.501722  10.518126  10.573835  10.674624  10.781898
826  0.465973  0.382286  10.776242  10.518126  10.573835  10.674624
827  0.404729  0.369280  11.480411  10.776242  10.518126  10.573835
828  0.375852  0.358995  10.411403  11.480411  10.776242  10.518126
829  0.347922  0.376135  10.294997  10.411403  11.480411  10.776242

           t-6        t-7        t-8  temp(t-1)  temp(t-2)  temp(t-3)  \
473  12.735907  12.308851  12.048499       9.04       7.99      13.14
474  11.481859  12.735907  12.308851       7.53       9.04       7.99
475  10.860481  11.481859  12.735907       0.33       7.53       9.04
476  10.675248  10.860481  11.481859      -4.11       0.33       7.53
477  10.889469  10.675248  10.860481      -0.56      -4.11       0.33
478  10.930170  10.889469  10.675248       3.01      -0.56      -4.11
479  11.559878  10.930170  10.889469       5.17       3.01      -0.56
```

480	12.823073	11.559878	10.930170	4.56	5.17	3.01
481	13.106773	12.823073	11.559878	3.91	4.56	5.17
482	12.852295	13.106773	12.823073	5.13	3.91	4.56
483	12.119938	12.852295	13.106773	7.06	5.13	3.91
484	11.786082	12.119938	12.852295	5.81	7.06	5.13
485	11.590859	11.786082	12.119938	3.49	5.81	7.06
486	12.186487	11.590859	11.786082	2.57	3.49	5.81
487	12.577783	12.186487	11.590859	0.07	2.57	3.49
488	11.816573	12.577783	12.186487	-2.27	0.07	2.57
489	11.387627	11.816573	12.577783	-2.86	-2.27	0.07
490	11.663214	11.387627	11.816573	-2.89	-2.86	-2.27
491	11.504756	11.663214	11.387627	-2.29	-2.89	-2.86
492	12.071173	11.504756	11.663214	-0.19	-2.29	-2.89
493	13.429271	12.071173	11.504756	0.31	-0.19	-2.29
494	14.191591	13.429271	12.071173	1.71	0.31	-0.19
495	13.118295	14.191591	13.429271	1.53	1.71	0.31
496	12.916559	13.118295	14.191591	1.29	1.53	1.71
497	12.496044	12.916559	13.118295	1.64	1.29	1.53
498	12.050954	12.496044	12.916559	3.74	1.64	1.29
499	12.231576	12.050954	12.496044	-0.57	3.74	1.64
500	11.791904	12.231576	12.050954	-1.57	-0.57	3.74
501	11.932721	11.791904	12.231576	3.68	-1.57	-0.57
502	11.932721	11.932721	11.791904	8.53	3.68	-1.57
..	...	...	...	...	...	...
800	11.300414	11.109560	11.370601	6.34	4.34	5.99
801	11.409880	11.300414	11.109560	2.53	6.34	4.34
802	11.620778	11.409880	11.300414	5.86	2.53	6.34
803	12.729659	11.620778	11.409880	5.27	5.86	2.53
804	11.753871	12.729659	11.620778	6.86	5.27	5.86
805	11.344805	11.753871	12.729659	6.48	6.86	5.27
806	11.800777	11.344805	11.753871	4.59	6.48	6.86
807	11.685169	11.800777	11.344805	5.63	4.59	6.48
808	11.857957	11.685169	11.800777	5.86	5.63	4.59
809	11.710582	11.857957	11.685169	7.34	5.86	5.63
810	12.078164	11.710582	11.857957	8.44	7.34	5.86
811	11.280011	12.078164	11.710582	5.67	8.44	7.34
812	11.095584	11.280011	12.078164	3.91	5.67	8.44
813	11.415105	11.095584	11.280011	7.07	3.91	5.67
814	11.445403	11.415105	11.095584	4.06	7.07	3.91
815	10.972318	11.445403	11.415105	4.73	4.06	7.07
816	11.569300	10.972318	11.445403	3.42	4.73	4.06
817	12.202967	11.569300	10.972318	12.02	3.42	4.73
818	11.264175	12.202967	11.569300	5.79	12.02	3.42
819	11.452649	11.264175	12.202967	7.88	5.79	12.02
820	11.679099	11.452649	11.264175	10.67	7.88	5.79
821	11.285737	11.679099	11.452649	10.13	10.67	7.88
822	11.816914	11.285737	11.679099	10.13	10.13	10.67
823	11.490470	11.816914	11.285737	12.50	10.13	10.13

824	11.582159	11.490470	11.816914	10.15	12.50	10.13
825	10.979566	11.582159	11.490470	11.63	10.15	12.50
826	10.781898	10.979566	11.582159	11.94	11.63	10.15
827	10.674624	10.781898	10.979566	14.23	11.94	11.63
828	10.573835	10.674624	10.781898	11.43	14.23	11.94
829	10.518126	10.573835	10.674624	11.29	11.43	14.23

	temp(t-4)	temp(t-5)	temp(t-6)	temp(t-7)	temp(t-8)
473	16.06	6.17	5.04	3.13	3.28
474	13.14	16.06	6.17	5.04	3.13
475	7.99	13.14	16.06	6.17	5.04
476	9.04	7.99	13.14	16.06	6.17
477	7.53	9.04	7.99	13.14	16.06
478	0.33	7.53	9.04	7.99	13.14
479	-4.11	0.33	7.53	9.04	7.99
480	-0.56	-4.11	0.33	7.53	9.04
481	3.01	-0.56	-4.11	0.33	7.53
482	5.17	3.01	-0.56	-4.11	0.33
483	4.56	5.17	3.01	-0.56	-4.11
484	3.91	4.56	5.17	3.01	-0.56
485	5.13	3.91	4.56	5.17	3.01
486	7.06	5.13	3.91	4.56	5.17
487	5.81	7.06	5.13	3.91	4.56
488	3.49	5.81	7.06	5.13	3.91
489	2.57	3.49	5.81	7.06	5.13
490	0.07	2.57	3.49	5.81	7.06
491	-2.27	0.07	2.57	3.49	5.81
492	-2.86	-2.27	0.07	2.57	3.49
493	-2.89	-2.86	-2.27	0.07	2.57
494	-2.29	-2.89	-2.86	-2.27	0.07
495	-0.19	-2.29	-2.89	-2.86	-2.27
496	0.31	-0.19	-2.29	-2.89	-2.86
497	1.71	0.31	-0.19	-2.29	-2.89
498	1.53	1.71	0.31	-0.19	-2.29
499	1.29	1.53	1.71	0.31	-0.19
500	1.64	1.29	1.53	1.71	0.31
501	3.74	1.64	1.29	1.53	1.71
502	-0.57	3.74	1.64	1.29	1.53
..	...	...	...	...	...
800	11.77	5.72	4.93	10.02	6.26
801	5.99	11.77	5.72	4.93	10.02
802	4.34	5.99	11.77	5.72	4.93
803	6.34	4.34	5.99	11.77	5.72
804	2.53	6.34	4.34	5.99	11.77
805	5.86	2.53	6.34	4.34	5.99
806	5.27	5.86	2.53	6.34	4.34
807	6.86	5.27	5.86	2.53	6.34
808	6.48	6.86	5.27	5.86	2.53

```
809       4.59       6.48       6.86       5.27       5.86
810       5.63       4.59       6.48       6.86       5.27
811       5.86       5.63       4.59       6.48       6.86
812       7.34       5.86       5.63       4.59       6.48
813       8.44       7.34       5.86       5.63       4.59
814       5.67       8.44       7.34       5.86       5.63
815       3.91       5.67       8.44       7.34       5.86
816       7.07       3.91       5.67       8.44       7.34
817       4.06       7.07       3.91       5.67       8.44
818       4.73       4.06       7.07       3.91       5.67
819       3.42       4.73       4.06       7.07       3.91
820      12.02       3.42       4.73       4.06       7.07
821       5.79      12.02       3.42       4.73       4.06
822       7.88       5.79      12.02       3.42       4.73
823      10.67       7.88       5.79      12.02       3.42
824      10.13      10.67       7.88       5.79      12.02
825      10.13      10.13      10.67       7.88       5.79
826      12.50      10.13      10.13      10.67       7.88
827      10.15      12.50      10.13      10.13      10.67
828      11.63      10.15      12.50      10.13      10.13
829      11.94      11.63      10.15      12.50      10.13

[357 rows x 17 columns]
```

In [55]:
```
# Convert predictions back to normal values

predi = scaler.inverse_transform(prova)
print(predi[0][0])
print(predi[0][1])

#Les variables en posició 15 i 16 són predicció i y respectivament
```

```
11.114592110340794
11.559878061079399
```

In [57]:
```
#Fem una llista amb les prediccions i una llista amb y(valor real)

listpredi=list()
for i in range(len(predi)):
    listpredi.append(predi[i][0])
listpredi

listy=list()
for i in range(len(predi)):
    listy.append(predi[i][1])
listy
```

Out[57]:
```
[11.559878061079399,
 12.8230727297735,
```

```
13.1067729697477,
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 10.202945322371301,
 10.3563498993587]
```
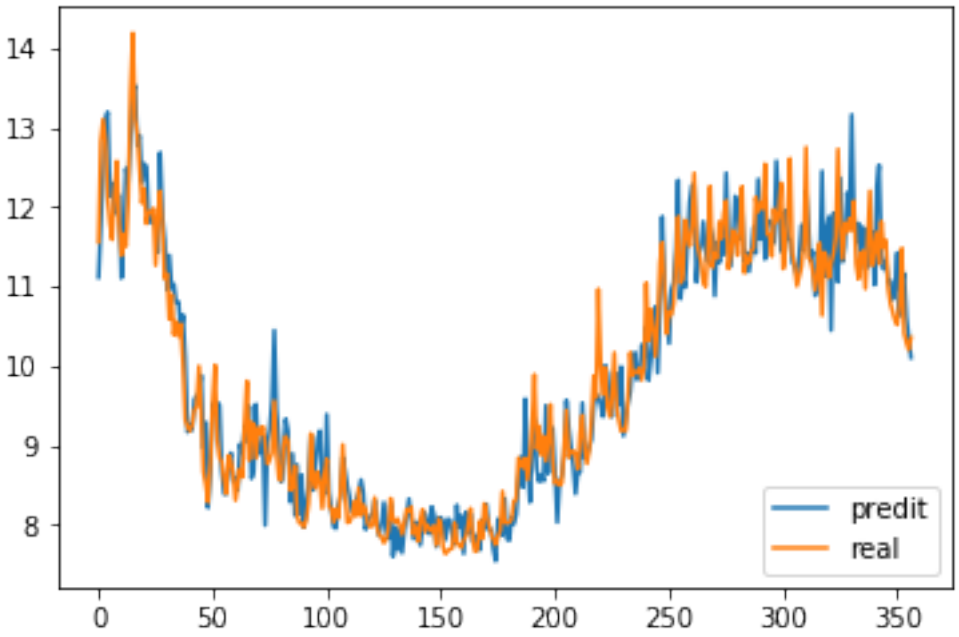
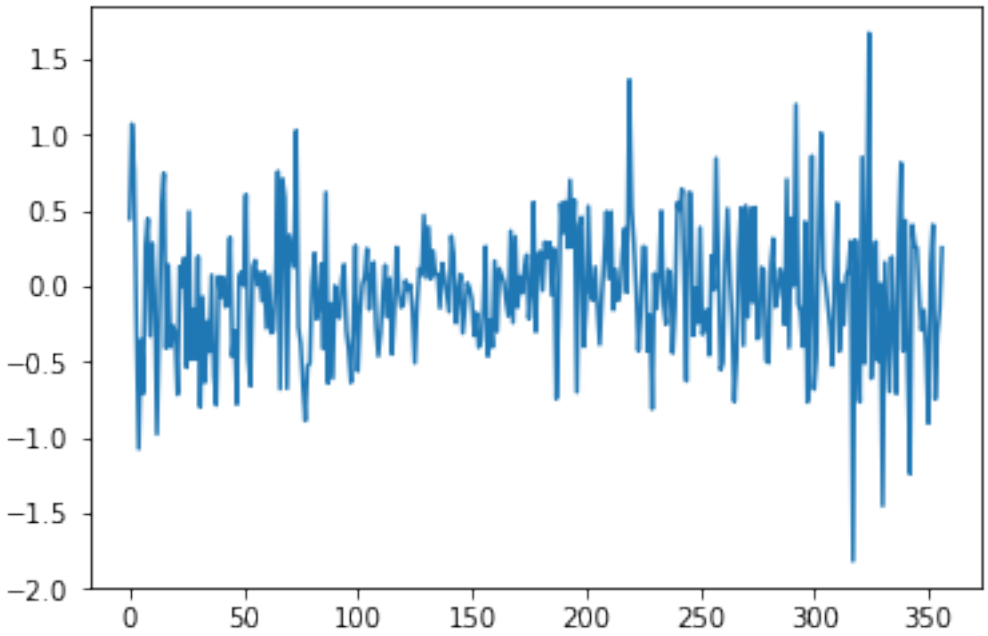
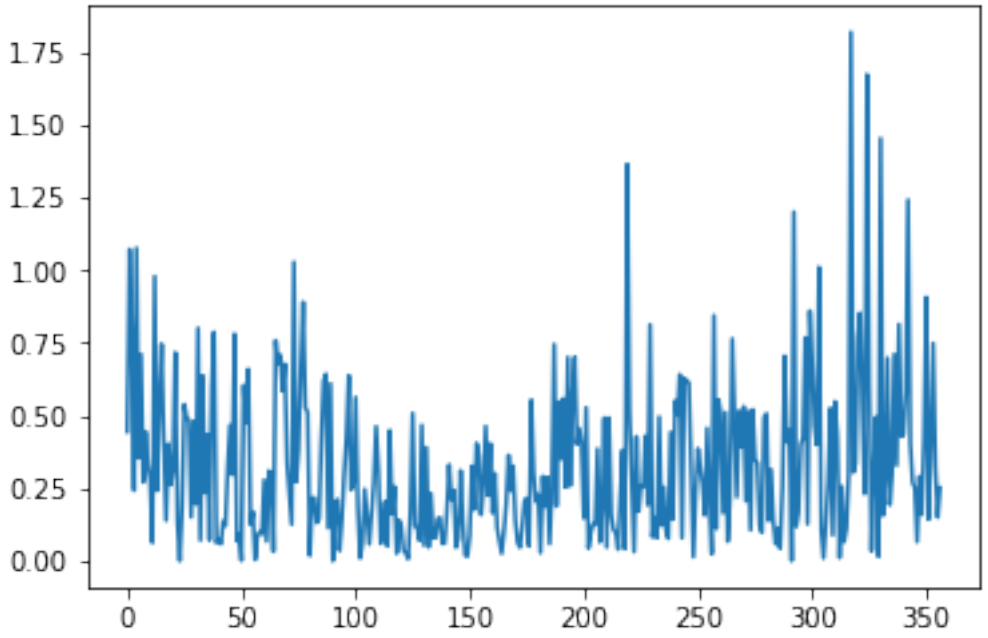

In [58]:
```
##Mostrem
plt.plot(listpredi, label="predit")
plt.plot(listy, label="real")
plt.legend(loc="lower right")
plt.show()
```



```
In [60]: listy[1]

Out[60]: 12.8230727297735

In [62]: llista_errors=list()
         llista_errorsabs=list()
         llista_errorsres=list()


         for i in range(len(listpredi)):
             valor=listy[i]-listpredi[i]
             valorabs=math.fabs(valor)
             valorrespecte=valorabs/listy[i]
             llista_errors.append(valor)
             llista_errorsabs.append(valorabs)
             llista_errorsres.append(valorrespecte)

In [63]: plt.plot(llista_errors)

Out[63]: [<matplotlib.lines.Line2D at 0x210febb4ef0>]
```

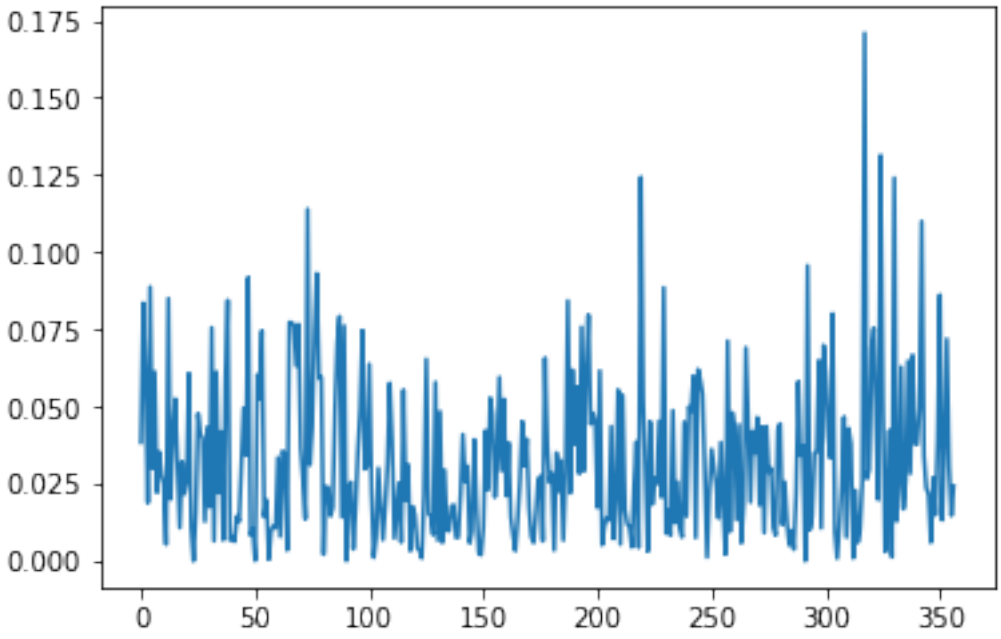



```
In [64]: plt.plot(llista_errorsabs)

Out[64]: [<matplotlib.lines.Line2D at 0x210fec15ba8>]
```



In [69]: plt.plot(llista_errorsres)

Out[69]: [<matplotlib.lines.Line2D at 0x210fecebf28>]



```
In [70]: sum(llista_errorsres)/(len(llista_errorsres))

Out[70]: 0.0327493809766566

In [ ]:
```