# MM5
# _Xarxa_walkforward_normalitzat_multivariate2_multistep

December 21, 2019

## 1 Xarxa neuronal

```
In [17]: 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
```

### 1.1 Consum diari total multivariate one-step

```
In [18]: daily=pd.read_csv('C:/Users/Laura/Desktop/Smart meters London/workspace R/Dades netes/
         daily.head(5)
```

Out[18]:

| | 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
```

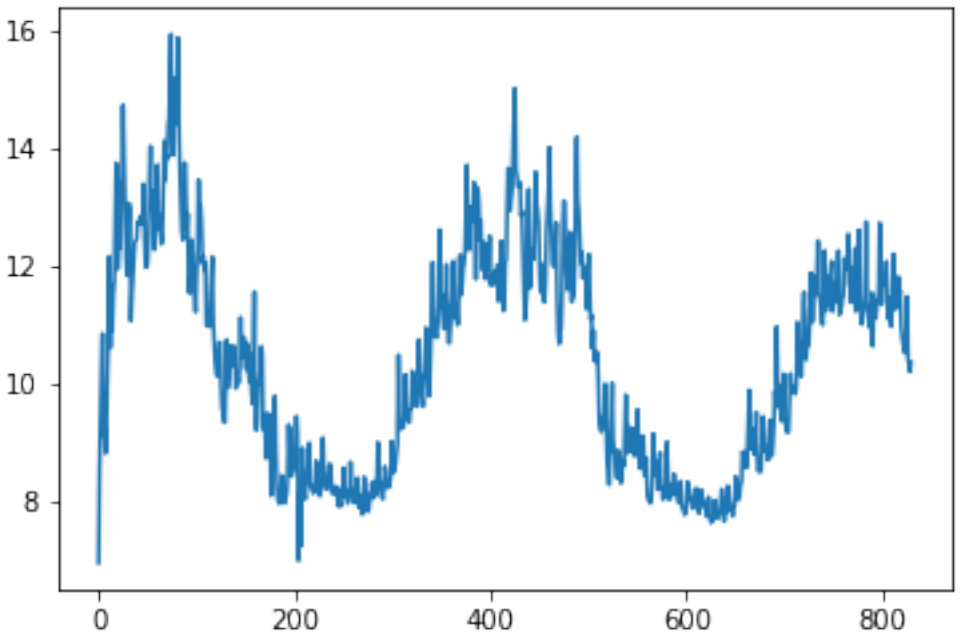
In [19]:
```
#Ens quedem amb date i energy_sum, ordenem valors per data i resetejem index
daily_dia=daily[['date','energy_sum','apparentTemperatureMax','humidity']].sort_values
daily_dia.head(5)
```

Out[19]:

| | index | date | energy_sum | apparentTemperatureMax | humidity |
|---|---|---|---|---|---|
| 0 | 677 | 2011-11-23 | 6.952692 | 10.36 | 0.93 |
| 1 | 691 | 2011-11-24 | 8.536480 | 12.93 | 0.89 |
| 2 | 713 | 2011-11-25 | 9.499781 | 13.03 | 0.79 |
| 3 | 728 | 2011-11-26 | 10.267707 | 12.96 | 0.81 |
| 4 | 729 | 2011-11-27 | 10.850805 | 13.54 | 0.72 |

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

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




In [20]:
```
daily_dia['y+1']=daily_dia['energy_sum'].shift(-1)
daily_dia['y+2']=daily_dia['energy_sum'].shift(-2)
daily_dia['y+3']=daily_dia['energy_sum'].shift(-3)
daily_dia['y+4']=daily_dia['energy_sum'].shift(-4)
daily_dia['y+5']=daily_dia['energy_sum'].shift(-5)
daily_dia['y+6']=daily_dia['energy_sum'].shift(-6)

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

```
daily_dia
```

Out[20]:

| | index | date | energy_sum | apparentTemperatureMax | humidity | \ |
|---|---|---|---|---|---|---|
| 0 | 677 | 2011-11-23 | 6.952692 | 10.36 | 0.93 | |
| 1 | 691 | 2011-11-24 | 8.536480 | 12.93 | 0.89 | |
| 2 | 713 | 2011-11-25 | 9.499781 | 13.03 | 0.79 | |
| 3 | 728 | 2011-11-26 | 10.267707 | 12.96 | 0.81 | |
| 4 | 729 | 2011-11-27 | 10.850805 | 13.54 | 0.72 | |
| 5 | 704 | 2011-11-28 | 9.103382 | 12.58 | 0.86 | |
| 6 | 718 | 2011-11-29 | 9.274873 | 13.47 | 0.82 | |
| 7 | 727 | 2011-11-30 | 8.813513 | 11.87 | 0.78 | |
| 8 | 778 | 2011-12-01 | 9.227707 | 12.15 | 0.82 | |
| 9 | 773 | 2011-12-02 | 10.145910 | 5.33 | 0.87 | |
| 10 | 791 | 2011-12-03 | 10.780273 | 11.42 | 0.79 | |
| 11 | 822 | 2011-12-04 | 12.163127 | 6.66 | 0.82 | |
| 12 | 807 | 2011-12-05 | 10.609714 | 3.13 | 0.77 | |
| 13 | 813 | 2011-12-06 | 11.673417 | 3.77 | 0.83 | |
| 14 | 810 | 2011-12-07 | 10.889362 | 5.14 | 0.68 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | 788 | 2011-12-08 | 11.525150 | 12.89 | 0.81 | |
| 16 | 797 | 2011-12-09 | 11.759837 | 3.99 | 0.71 | |
| 17 | 799 | 2011-12-10 | 12.633801 | 3.14 | 0.81 | |
| 18 | 776 | 2011-12-11 | 13.749174 | 5.72 | 0.88 | |
| 19 | 775 | 2011-12-12 | 11.951958 | 5.94 | 0.84 | |
| 20 | 786 | 2011-12-13 | 11.957446 | 12.08 | 0.75 | |
| 21 | 818 | 2011-12-14 | 12.392776 | 2.88 | 0.79 | |
| 22 | 795 | 2011-12-15 | 12.307079 | 4.38 | 0.77 | |
| 23 | 763 | 2011-12-16 | 13.376080 | 0.99 | 0.88 | |
| 24 | 770 | 2011-12-17 | 13.511968 | 1.72 | 0.86 | |
| 25 | 808 | 2011-12-18 | 14.732271 | 1.98 | 0.84 | |
| 26 | 757 | 2011-12-19 | 13.774471 | 4.02 | 0.94 | |
| 27 | 803 | 2011-12-20 | 12.709106 | 4.98 | 0.81 | |
| 28 | 748 | 2011-12-21 | 12.148570 | 12.14 | 0.94 | |
| 29 | 806 | 2011-12-22 | 11.839403 | 12.14 | 0.87 | |
| .. | ... | ... | ... | ... | ... | |
| 800 | 21 | 2014-01-29 | 11.800777 | 2.53 | 0.90 | |
| 801 | 10 | 2014-01-30 | 11.685169 | 5.86 | 0.91 | |
| 802 | 12 | 2014-01-31 | 11.857957 | 5.27 | 0.91 | |
| 803 | 129 | 2014-02-01 | 11.710582 | 6.86 | 0.76 | |
| 804 | 155 | 2014-02-02 | 12.078164 | 6.48 | 0.72 | |
| 805 | 145 | 2014-02-03 | 11.280011 | 4.59 | 0.79 | |
| 806 | 134 | 2014-02-04 | 11.095584 | 5.63 | 0.75 | |
| 807 | 123 | 2014-02-05 | 11.415105 | 5.86 | 0.77 | |
| 808 | 118 | 2014-02-06 | 11.445403 | 7.34 | 0.82 | |
| 809 | 122 | 2014-02-07 | 10.972318 | 8.44 | 0.79 | |
| 810 | 126 | 2014-02-08 | 11.569300 | 5.67 | 0.77 | |
| 811 | 149 | 2014-02-09 | 12.202967 | 3.91 | 0.66 | |
| 812 | 132 | 2014-02-10 | 11.264175 | 7.07 | 0.84 | |
| 813 | 143 | 2014-02-11 | 11.452649 | 4.06 | 0.76 | |
| 814 | 131 | 2014-02-12 | 11.679099 | 4.73 | 0.75 | |
| 815 | 164 | 2014-02-13 | 11.285737 | 3.42 | 0.68 | |
| 816 | 125 | 2014-02-14 | 11.816914 | 12.02 | 0.81 | |
| 817 | 141 | 2014-02-15 | 11.490470 | 5.79 | 0.69 | |
| 818 | 151 | 2014-02-16 | 11.582159 | 7.88 | 0.76 | |
| 819 | 116 | 2014-02-17 | 10.979566 | 10.67 | 0.83 | |
| 820 | 128 | 2014-02-18 | 10.781898 | 10.13 | 0.87 | |
| 821 | 115 | 2014-02-19 | 10.674624 | 10.13 | 0.87 | |
| 822 | 121 | 2014-02-20 | 10.573835 | 12.50 | 0.84 | |
| 823 | 174 | 2014-02-21 | 10.518126 | 10.15 | 0.72 | |
| 824 | 167 | 2014-02-22 | 10.776242 | 11.63 | 0.71 | |
| 825 | 139 | 2014-02-23 | 11.480411 | 11.94 | 0.76 | |
| 826 | 162 | 2014-02-24 | 10.411403 | 14.23 | 0.74 | |
| 827 | 136 | 2014-02-25 | 10.294997 | 11.43 | 0.78 | |
| 828 | 161 | 2014-02-26 | 10.202945 | 11.29 | 0.73 | |
| 829 | 133 | 2014-02-27 | 10.356350 | 10.31 | 0.74 | |

| | y+1 | y+2 | y+3 | y+4 | y+5 | ... | temp(t-7) | \ |
|---|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 8.536480 | 9.499781 | 10.267707 | 10.850805 | 9.103382 | ... | NaN |
| 1 | 9.499781 | 10.267707 | 10.850805 | 9.103382 | 9.274873 | ... | NaN |
| 2 | 10.267707 | 10.850805 | 9.103382 | 9.274873 | 8.813513 | ... | NaN |
| 3 | 10.850805 | 9.103382 | 9.274873 | 8.813513 | 9.227707 | ... | NaN |
| 4 | 9.103382 | 9.274873 | 8.813513 | 9.227707 | 10.145910 | ... | NaN |
| 5 | 9.274873 | 8.813513 | 9.227707 | 10.145910 | 10.780273 | ... | NaN |
| 6 | 8.813513 | 9.227707 | 10.145910 | 10.780273 | 12.163127 | ... | NaN |
| 7 | 9.227707 | 10.145910 | 10.780273 | 12.163127 | 10.609714 | ... | 10.36 |
| 8 | 10.145910 | 10.780273 | 12.163127 | 10.609714 | 11.673417 | ... | 12.93 |
| 9 | 10.780273 | 12.163127 | 10.609714 | 11.673417 | 10.889362 | ... | 13.03 |
| 10 | 12.163127 | 10.609714 | 11.673417 | 10.889362 | 11.525150 | ... | 12.96 |
| 11 | 10.609714 | 11.673417 | 10.889362 | 11.525150 | 11.759837 | ... | 13.54 |
| 12 | 11.673417 | 10.889362 | 11.525150 | 11.759837 | 12.633801 | ... | 12.58 |
| 13 | 10.889362 | 11.525150 | 11.759837 | 12.633801 | 13.749174 | ... | 13.47 |
| 14 | 11.525150 | 11.759837 | 12.633801 | 13.749174 | 11.951958 | ... | 11.87 |
| 15 | 11.759837 | 12.633801 | 13.749174 | 11.951958 | 11.957446 | ... | 12.15 |
| 16 | 12.633801 | 13.749174 | 11.951958 | 11.957446 | 12.392776 | ... | 5.33 |
| 17 | 13.749174 | 11.951958 | 11.957446 | 12.392776 | 12.307079 | ... | 11.42 |
| 18 | 11.951958 | 11.957446 | 12.392776 | 12.307079 | 13.376080 | ... | 6.66 |
| 19 | 11.957446 | 12.392776 | 12.307079 | 13.376080 | 13.511968 | ... | 3.13 |
| 20 | 12.392776 | 12.307079 | 13.376080 | 13.511968 | 14.732271 | ... | 3.77 |
| 21 | 12.307079 | 13.376080 | 13.511968 | 14.732271 | 13.774471 | ... | 5.14 |
| 22 | 13.376080 | 13.511968 | 14.732271 | 13.774471 | 12.709106 | ... | 12.89 |
| 23 | 13.511968 | 14.732271 | 13.774471 | 12.709106 | 12.148570 | ... | 3.99 |
| 24 | 14.732271 | 13.774471 | 12.709106 | 12.148570 | 11.839403 | ... | 3.14 |
| 25 | 13.774471 | 12.709106 | 12.148570 | 11.839403 | 12.254989 | ... | 5.72 |
| 26 | 12.709106 | 12.148570 | 11.839403 | 12.254989 | 13.065317 | ... | 5.94 |
| 27 | 12.148570 | 11.839403 | 12.254989 | 13.065317 | 12.949429 | ... | 12.08 |
| 28 | 11.839403 | 12.254989 | 13.065317 | 12.949429 | 11.065577 | ... | 2.88 |
| 29 | 12.254989 | 13.065317 | 12.949429 | 11.065577 | 11.494944 | ... | 4.38 |
| .. | ... | ... | ... | ... | ... | ... | ... |
| 800 | 11.685169 | 11.857957 | 11.710582 | 12.078164 | 11.280011 | ... | 10.02 |
| 801 | 11.857957 | 11.710582 | 12.078164 | 11.280011 | 11.095584 | ... | 4.93 |
| 802 | 11.710582 | 12.078164 | 11.280011 | 11.095584 | 11.415105 | ... | 5.72 |
| 803 | 12.078164 | 11.280011 | 11.095584 | 11.415105 | 11.445403 | ... | 11.77 |
| 804 | 11.280011 | 11.095584 | 11.415105 | 11.445403 | 10.972318 | ... | 5.99 |
| 805 | 11.095584 | 11.415105 | 11.445403 | 10.972318 | 11.569300 | ... | 4.34 |
| 806 | 11.415105 | 11.445403 | 10.972318 | 11.569300 | 12.202967 | ... | 6.34 |
| 807 | 11.445403 | 10.972318 | 11.569300 | 12.202967 | 11.264175 | ... | 2.53 |
| 808 | 10.972318 | 11.569300 | 12.202967 | 11.264175 | 11.452649 | ... | 5.86 |
| 809 | 11.569300 | 12.202967 | 11.264175 | 11.452649 | 11.679099 | ... | 5.27 |
| 810 | 12.202967 | 11.264175 | 11.452649 | 11.679099 | 11.285737 | ... | 6.86 |
| 811 | 11.264175 | 11.452649 | 11.679099 | 11.285737 | 11.816914 | ... | 6.48 |
| 812 | 11.452649 | 11.679099 | 11.285737 | 11.816914 | 11.490470 | ... | 4.59 |
| 813 | 11.679099 | 11.285737 | 11.816914 | 11.490470 | 11.582159 | ... | 5.63 |
| 814 | 11.285737 | 11.816914 | 11.490470 | 11.582159 | 10.979566 | ... | 5.86 |
| 815 | 11.816914 | 11.490470 | 11.582159 | 10.979566 | 10.781898 | ... | 7.34 |
| 816 | 11.490470 | 11.582159 | 10.979566 | 10.781898 | 10.674624 | ... | 8.44 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 817 | 11.582159 | 10.979566 | 10.781898 | 10.674624 | 10.573835 | ... | 5.67 |
| 818 | 10.979566 | 10.781898 | 10.674624 | 10.573835 | 10.518126 | ... | 3.91 |
| 819 | 10.781898 | 10.674624 | 10.573835 | 10.518126 | 10.776242 | ... | 7.07 |
| 820 | 10.674624 | 10.573835 | 10.518126 | 10.776242 | 11.480411 | ... | 4.06 |
| 821 | 10.573835 | 10.518126 | 10.776242 | 11.480411 | 10.411403 | ... | 4.73 |
| 822 | 10.518126 | 10.776242 | 11.480411 | 10.411403 | 10.294997 | ... | 3.42 |
| 823 | 10.776242 | 11.480411 | 10.411403 | 10.294997 | 10.202945 | ... | 12.02 |
| 824 | 11.480411 | 10.411403 | 10.294997 | 10.202945 | 10.356350 | ... | 5.79 |
| 825 | 10.411403 | 10.294997 | 10.202945 | 10.356350 | NaN | ... | 7.88 |
| 826 | 10.294997 | 10.202945 | 10.356350 | NaN | NaN | ... | 10.67 |
| 827 | 10.202945 | 10.356350 | NaN | NaN | NaN | ... | 10.13 |
| 828 | 10.356350 | NaN | NaN | NaN | NaN | ... | 10.13 |
| 829 | NaN | NaN | NaN | NaN | NaN | ... | 12.50 |

| | temp(t-8) | humidity(t-1) | humidity(t-2) | humidity(t-3) | humidity(t-4) | \ |
|---|---|---|---|---|---|---|
| 0 | NaN | NaN | NaN | NaN | NaN | |
| 1 | NaN | 0.93 | NaN | NaN | NaN | |
| 2 | NaN | 0.89 | 0.93 | NaN | NaN | |
| 3 | NaN | 0.79 | 0.89 | 0.93 | NaN | |
| 4 | NaN | 0.81 | 0.79 | 0.89 | 0.93 | |
| 5 | NaN | 0.72 | 0.81 | 0.79 | 0.89 | |
| 6 | NaN | 0.86 | 0.72 | 0.81 | 0.79 | |
| 7 | NaN | 0.82 | 0.86 | 0.72 | 0.81 | |
| 8 | 10.36 | 0.78 | 0.82 | 0.86 | 0.72 | |
| 9 | 12.93 | 0.82 | 0.78 | 0.82 | 0.86 | |
| 10 | 13.03 | 0.87 | 0.82 | 0.78 | 0.82 | |
| 11 | 12.96 | 0.79 | 0.87 | 0.82 | 0.78 | |
| 12 | 13.54 | 0.82 | 0.79 | 0.87 | 0.82 | |
| 13 | 12.58 | 0.77 | 0.82 | 0.79 | 0.87 | |
| 14 | 13.47 | 0.83 | 0.77 | 0.82 | 0.79 | |
| 15 | 11.87 | 0.68 | 0.83 | 0.77 | 0.82 | |
| 16 | 12.15 | 0.81 | 0.68 | 0.83 | 0.77 | |
| 17 | 5.33 | 0.71 | 0.81 | 0.68 | 0.83 | |
| 18 | 11.42 | 0.81 | 0.71 | 0.81 | 0.68 | |
| 19 | 6.66 | 0.88 | 0.81 | 0.71 | 0.81 | |
| 20 | 3.13 | 0.84 | 0.88 | 0.81 | 0.71 | |
| 21 | 3.77 | 0.75 | 0.84 | 0.88 | 0.81 | |
| 22 | 5.14 | 0.79 | 0.75 | 0.84 | 0.88 | |
| 23 | 12.89 | 0.77 | 0.79 | 0.75 | 0.84 | |
| 24 | 3.99 | 0.88 | 0.77 | 0.79 | 0.75 | |
| 25 | 3.14 | 0.86 | 0.88 | 0.77 | 0.79 | |
| 26 | 5.72 | 0.84 | 0.86 | 0.88 | 0.77 | |
| 27 | 5.94 | 0.94 | 0.84 | 0.86 | 0.88 | |
| 28 | 12.08 | 0.81 | 0.94 | 0.84 | 0.86 | |
| 29 | 2.88 | 0.94 | 0.81 | 0.94 | 0.84 | |
| .. | ... | ... | ... | ... | ... | |
| 800 | 6.26 | 0.83 | 0.79 | 0.79 | 0.83 | |
| 801 | 10.02 | 0.90 | 0.83 | 0.79 | 0.79 | |

| | | | | | |
|---|---|---|---|---|---|
| 802 | 4.93 | 0.91 | 0.90 | 0.83 | 0.79 |
| 803 | 5.72 | 0.91 | 0.91 | 0.90 | 0.83 |
| 804 | 11.77 | 0.76 | 0.91 | 0.91 | 0.90 |
| 805 | 5.99 | 0.72 | 0.76 | 0.91 | 0.91 |
| 806 | 4.34 | 0.79 | 0.72 | 0.76 | 0.91 |
| 807 | 6.34 | 0.75 | 0.79 | 0.72 | 0.76 |
| 808 | 2.53 | 0.77 | 0.75 | 0.79 | 0.72 |
| 809 | 5.86 | 0.82 | 0.77 | 0.75 | 0.79 |
| 810 | 5.27 | 0.79 | 0.82 | 0.77 | 0.75 |
| 811 | 6.86 | 0.77 | 0.79 | 0.82 | 0.77 |
| 812 | 6.48 | 0.66 | 0.77 | 0.79 | 0.82 |
| 813 | 4.59 | 0.84 | 0.66 | 0.77 | 0.79 |
| 814 | 5.63 | 0.76 | 0.84 | 0.66 | 0.77 |
| 815 | 5.86 | 0.75 | 0.76 | 0.84 | 0.66 |
| 816 | 7.34 | 0.68 | 0.75 | 0.76 | 0.84 |
| 817 | 8.44 | 0.81 | 0.68 | 0.75 | 0.76 |
| 818 | 5.67 | 0.69 | 0.81 | 0.68 | 0.75 |
| 819 | 3.91 | 0.76 | 0.69 | 0.81 | 0.68 |
| 820 | 7.07 | 0.83 | 0.76 | 0.69 | 0.81 |
| 821 | 4.06 | 0.87 | 0.83 | 0.76 | 0.69 |
| 822 | 4.73 | 0.87 | 0.87 | 0.83 | 0.76 |
| 823 | 3.42 | 0.84 | 0.87 | 0.87 | 0.83 |
| 824 | 12.02 | 0.72 | 0.84 | 0.87 | 0.87 |
| 825 | 5.79 | 0.71 | 0.72 | 0.84 | 0.87 |
| 826 | 7.88 | 0.76 | 0.71 | 0.72 | 0.84 |
| 827 | 10.67 | 0.74 | 0.76 | 0.71 | 0.72 |
| 828 | 10.13 | 0.78 | 0.74 | 0.76 | 0.71 |
| 829 | 10.13 | 0.73 | 0.78 | 0.74 | 0.76 |

| | humidity(t-5) | humidity(t-6) | humidity(t-7) | humidity(t-8) |
|---|---|---|---|---|
| 0 | NaN | NaN | NaN | NaN |
| 1 | NaN | NaN | NaN | NaN |
| 2 | NaN | NaN | NaN | NaN |
| 3 | NaN | NaN | NaN | NaN |
| 4 | NaN | NaN | NaN | NaN |
| 5 | 0.93 | NaN | NaN | NaN |
| 6 | 0.89 | 0.93 | NaN | NaN |
| 7 | 0.79 | 0.89 | 0.93 | NaN |
| 8 | 0.81 | 0.79 | 0.89 | 0.93 |
| 9 | 0.72 | 0.81 | 0.79 | 0.89 |
| 10 | 0.86 | 0.72 | 0.81 | 0.79 |
| 11 | 0.82 | 0.86 | 0.72 | 0.81 |
| 12 | 0.78 | 0.82 | 0.86 | 0.72 |
| 13 | 0.82 | 0.78 | 0.82 | 0.86 |
| 14 | 0.87 | 0.82 | 0.78 | 0.82 |
| 15 | 0.79 | 0.87 | 0.82 | 0.78 |
| 16 | 0.82 | 0.79 | 0.87 | 0.82 |
| 17 | 0.77 | 0.82 | 0.79 | 0.87 |

| | | | | |
|---|---|---|---|---|
| 18 | 0.83 | 0.77 | 0.82 | 0.79 |
| 19 | 0.68 | 0.83 | 0.77 | 0.82 |
| 20 | 0.81 | 0.68 | 0.83 | 0.77 |
| 21 | 0.71 | 0.81 | 0.68 | 0.83 |
| 22 | 0.81 | 0.71 | 0.81 | 0.68 |
| 23 | 0.88 | 0.81 | 0.71 | 0.81 |
| 24 | 0.84 | 0.88 | 0.81 | 0.71 |
| 25 | 0.75 | 0.84 | 0.88 | 0.81 |
| 26 | 0.79 | 0.75 | 0.84 | 0.88 |
| 27 | 0.77 | 0.79 | 0.75 | 0.84 |
| 28 | 0.88 | 0.77 | 0.79 | 0.75 |
| 29 | 0.86 | 0.88 | 0.77 | 0.79 |
| .. | ... | ... | ... | ... |
| 800 | 0.83 | 0.82 | 0.87 | 0.89 |
| 801 | 0.83 | 0.83 | 0.82 | 0.87 |
| 802 | 0.79 | 0.83 | 0.83 | 0.82 |
| 803 | 0.79 | 0.79 | 0.83 | 0.83 |
| 804 | 0.83 | 0.79 | 0.79 | 0.83 |
| 805 | 0.90 | 0.83 | 0.79 | 0.79 |
| 806 | 0.91 | 0.90 | 0.83 | 0.79 |
| 807 | 0.91 | 0.91 | 0.90 | 0.83 |
| 808 | 0.76 | 0.91 | 0.91 | 0.90 |
| 809 | 0.72 | 0.76 | 0.91 | 0.91 |
| 810 | 0.79 | 0.72 | 0.76 | 0.91 |
| 811 | 0.75 | 0.79 | 0.72 | 0.76 |
| 812 | 0.77 | 0.75 | 0.79 | 0.72 |
| 813 | 0.82 | 0.77 | 0.75 | 0.79 |
| 814 | 0.79 | 0.82 | 0.77 | 0.75 |
| 815 | 0.77 | 0.79 | 0.82 | 0.77 |
| 816 | 0.66 | 0.77 | 0.79 | 0.82 |
| 817 | 0.84 | 0.66 | 0.77 | 0.79 |
| 818 | 0.76 | 0.84 | 0.66 | 0.77 |
| 819 | 0.75 | 0.76 | 0.84 | 0.66 |
| 820 | 0.68 | 0.75 | 0.76 | 0.84 |
| 821 | 0.81 | 0.68 | 0.75 | 0.76 |
| 822 | 0.69 | 0.81 | 0.68 | 0.75 |
| 823 | 0.76 | 0.69 | 0.81 | 0.68 |
| 824 | 0.83 | 0.76 | 0.69 | 0.81 |
| 825 | 0.87 | 0.83 | 0.76 | 0.69 |
| 826 | 0.87 | 0.87 | 0.83 | 0.76 |
| 827 | 0.84 | 0.87 | 0.87 | 0.83 |
| 828 | 0.72 | 0.84 | 0.87 | 0.87 |
| 829 | 0.71 | 0.72 | 0.84 | 0.87 |

[830 rows x 35 columns]

In [21]:
```
#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.drop(['index','date','apparentTemperatureMax', 'humidity'], axis=
#daily_dia=daily_dia[['energy_sum','t-1','t-2','t-3','t-4','t-5','t-6','t-7','t-8','t
daily_dia.head(5)
```

Out[21]:

| | energy_sum | y+1 | y+2 | y+3 | y+4 | y+5 | \ |
|---|---|---|---|---|---|---|---|
| 0 | 6.952692 | 8.536480 | 9.499781 | 10.267707 | 10.850805 | 9.103382 | |
| 1 | 8.536480 | 9.499781 | 10.267707 | 10.850805 | 9.103382 | 9.274873 | |
| 2 | 9.499781 | 10.267707 | 10.850805 | 9.103382 | 9.274873 | 8.813513 | |
| 3 | 10.267707 | 10.850805 | 9.103382 | 9.274873 | 8.813513 | 9.227707 | |
| 4 | 10.850805 | 9.103382 | 9.274873 | 8.813513 | 9.227707 | 10.145910 | |

| | y+6 | t-1 | t-2 | t-3 | ... | temp(t-7) | temp(t-8) | \ |
|---|---|---|---|---|---|---|---|---|
| 0 | 9.274873 | NaN | NaN | NaN | ... | NaN | NaN | |
| 1 | 8.813513 | 6.952692 | NaN | NaN | ... | NaN | NaN | |
| 2 | 9.227707 | 8.536480 | 6.952692 | NaN | ... | NaN | NaN | |
| 3 | 10.145910 | 9.499781 | 8.536480 | 6.952692 | ... | NaN | NaN | |
| 4 | 10.780273 | 10.267707 | 9.499781 | 8.536480 | ... | NaN | NaN | |

| | humidity(t-1) | humidity(t-2) | humidity(t-3) | humidity(t-4) | humidity(t-5) | \ |
|---|---|---|---|---|---|---|
| 0 | NaN | NaN | NaN | NaN | NaN | |
| 1 | 0.93 | NaN | NaN | NaN | NaN | |
| 2 | 0.89 | 0.93 | NaN | NaN | NaN | |
| 3 | 0.79 | 0.89 | 0.93 | NaN | NaN | |
| 4 | 0.81 | 0.79 | 0.89 | 0.93 | NaN | |

| | humidity(t-6) | humidity(t-7) | humidity(t-8) |
|---|---|---|---|
| 0 | NaN | NaN | NaN |
| 1 | NaN | NaN | NaN |
| 2 | NaN | NaN | NaN |
| 3 | NaN | NaN | NaN |
| 4 | NaN | NaN | NaN |

[5 rows x 31 columns]

In [22]:
```
#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=daily_dia.drop([829,828,827,826,825,824,823])
```

In [12]:
```
len(daily_dia)
```

Out[12]: 815

In [23]:
```
#normalitzem
scaler=preprocessing.MinMaxScaler(feature_range=(0, 1))
daily_dia_norm=scaler.fit_transform(daily_dia)
```

In [47]:

```
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 [24]: #Seleccionem dades per test i train
         y_daily=daily_dia_norm[:,0:7]

         X_daily=daily_dia_norm[:,7:34]

         #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], 8,3))
```

```
In [25]: # definim model
         import tensorflow as tf
         model =Sequential()
         model.add(LSTM(50, activation='relu', input_shape=(8, 3)))
         model.add(Dense(7))
         model.compile(optimizer='adam', loss='mse', metrics=['accuracy'])
```

```
In [26]: 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
```

In [27]:
```
#Dividim la suma de scores de test entre el nombre de prediccions per obtenir la mitj
sumScores/(lenght-n_train)
```

Out[27]:
```
0.06174840522580044
```

In [28]:
```
#Fem llista amb les prediccions
llista_p=list()
for i in range(len(llista_prediccions)):
    llista_p.append(llista_prediccions[i].tolist())

llista_p
```

Out[28]:
```
[[[0.4309638440608978,
   0.4499463140964508,
   0.4545643925666809,
   0.4408312141895294,
   0.45970413088798523,
   0.4533982574939728,
   0.4505190849304199]],
 [[0.4756709635257721,
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   0.485994815826416]],
 [[0.5942603349685669,
   0.591539740562439,
```

```
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          0.5526617765426636,
          0.4675290286540985,
          0.32568952441215515]]]
```

In [29]:
```
#Fem llista amb la predicció de només el dia següent
llista_p0=list()
for i in range(len(llista_p)):
    llista_p0.append(llista_p[i][0][0])
```

In [30]:
```
#Fem llista amb la predicció de 2 dies
llista_p1=list()
for i in range(len(llista_p)):
    llista_p1.append(llista_p[i][0][1])
```

In [31]:
```
#Altres dies

llista_p2=list()
```

```
        for i in range(len(llista_p)):
            llista_p2.append(llista_p[i][0][2])

        llista_p3=list()
        for i in range(len(llista_p)):
            llista_p3.append(llista_p[i][0][3])

        llista_p4=list()
        for i in range(len(llista_p)):
            llista_p4.append(llista_p[i][0][4])

        llista_p5=list()
        for i in range(len(llista_p)):
            llista_p5.append(llista_p[i][0][5])

        llista_p6=list()
        for i in range(len(llista_p)):
            llista_p6.append(llista_p[i][0][6])
```

In [ ]:

In [32]:
```
score0=math.sqrt(mean_squared_error(y_daily[n_train:lenght,0], llista_p0))
print("Error predicció 1 dia següent: {}".format(score0))
score1=math.sqrt(mean_squared_error(y_daily[n_train:lenght,1], llista_p1))
print("Error predicció 2 dia següent: {}".format(score1))
score2=math.sqrt(mean_squared_error(y_daily[n_train:lenght,2], llista_p2))
print("Error predicció 3 dia següent: {}".format(score2))
score3=math.sqrt(mean_squared_error(y_daily[n_train:lenght,3], llista_p3))
print("Error predicció 4 dia següent: {}".format(score3))
score4=math.sqrt(mean_squared_error(y_daily[n_train:lenght,4], llista_p4))
print("Error predicció 5 dia següent: {}".format(score4))
score5=math.sqrt(mean_squared_error(y_daily[n_train:lenght,5], llista_p5))
print("Error predicció 6 dia següent: {}".format(score5))
score6=math.sqrt(mean_squared_error(y_daily[n_train:lenght,6], llista_p6))
print("Error predicció 7 dia següent: {}".format(score6))
```

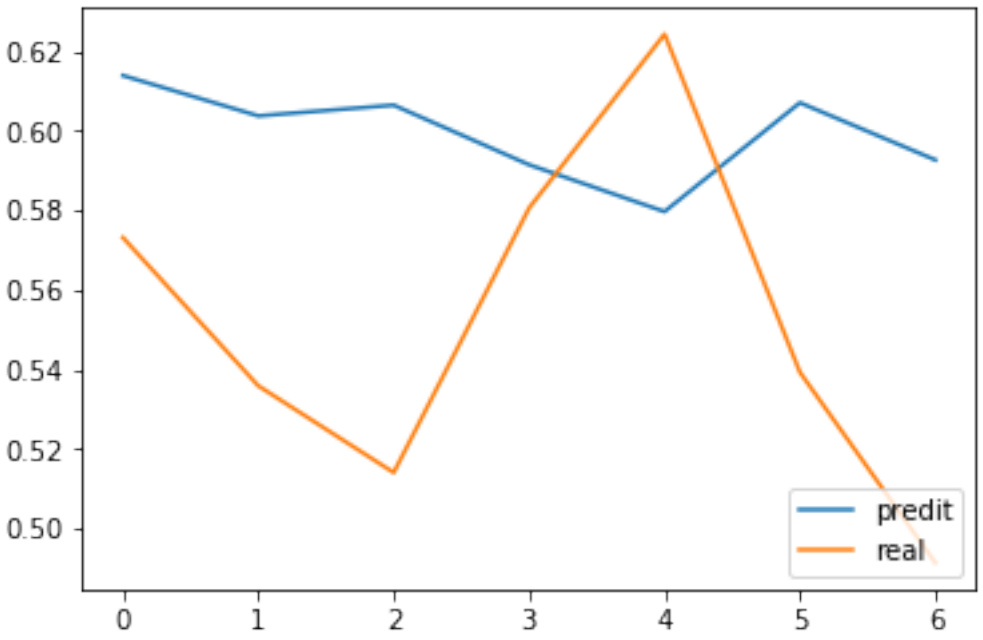
```
Error predicció 1 dia següent: 0.05497597267198229
Error predicció 2 dia següent: 0.06539538083113881
Error predicció 3 dia següent: 0.06645250095335278
Error predicció 4 dia següent: 0.07547615319377224
Error predicció 5 dia següent: 0.07561944031302781
Error predicció 6 dia següent: 0.07365796705366427
Error predicció 7 dia següent: 0.08132622551591406
```

In [33]:
```
predis=list()

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

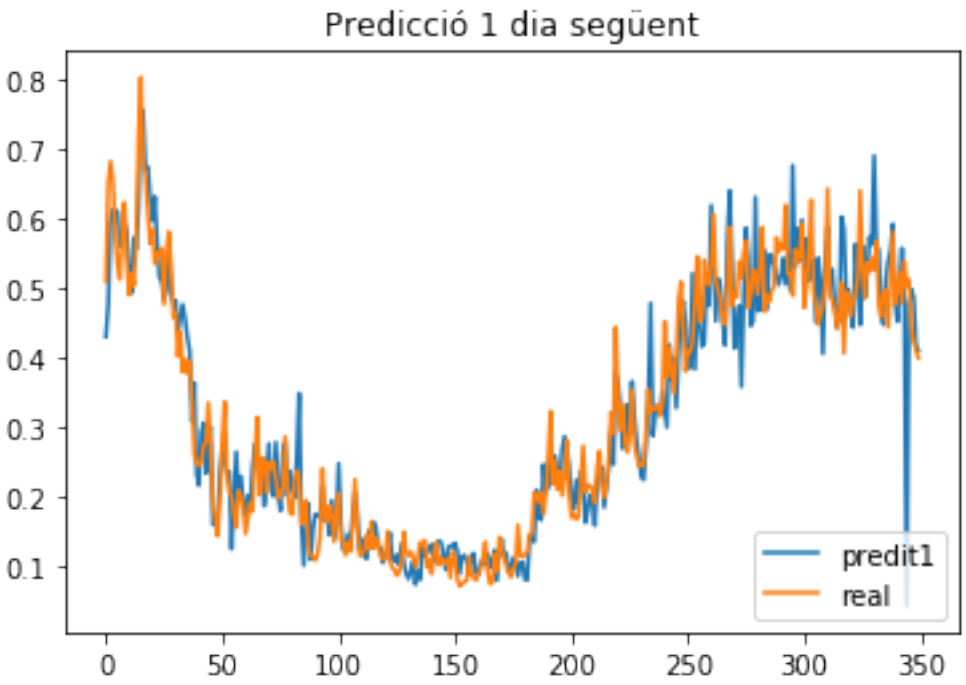
```
            predis.append(predi)

        predis=np.reshape(predis, (len(llista_prediccions),7)  )

        predis
```

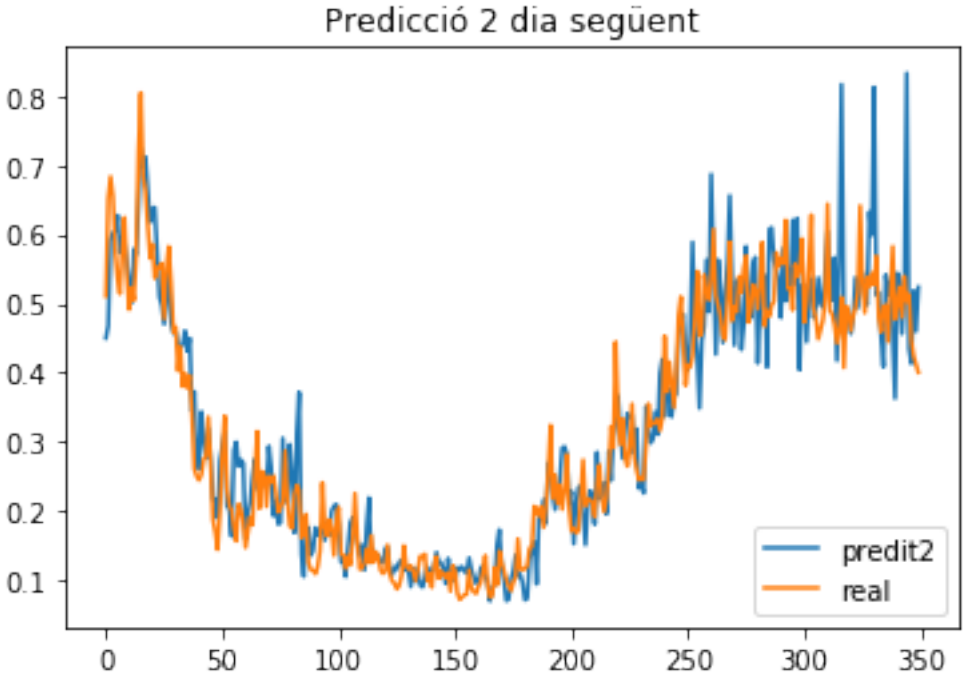
Out[33]:
```
array([[0.43096384, 0.44994631, 0.45456439, ..., 0.45970413, 0.45339826,
        0.45051908],
       [0.47567096, 0.46758938, 0.48496729, ..., 0.47240528, 0.48359954,
        0.48599482],
       [0.59426033, 0.59153974, 0.57879877, ..., 0.6005975 , 0.58785409,
        0.57425892],
       ...,
       [0.48733902, 0.51844108, 0.47610363, ..., 0.53270078, 0.54558694,
        0.52058977],
       [0.41926044, 0.45989826, 0.48782709, ..., 0.49390519, 0.44347051,
        0.31859264],
       [0.41103131, 0.52364773, 0.43167081, ..., 0.55266178, 0.46752903,
        0.32568952]])
```

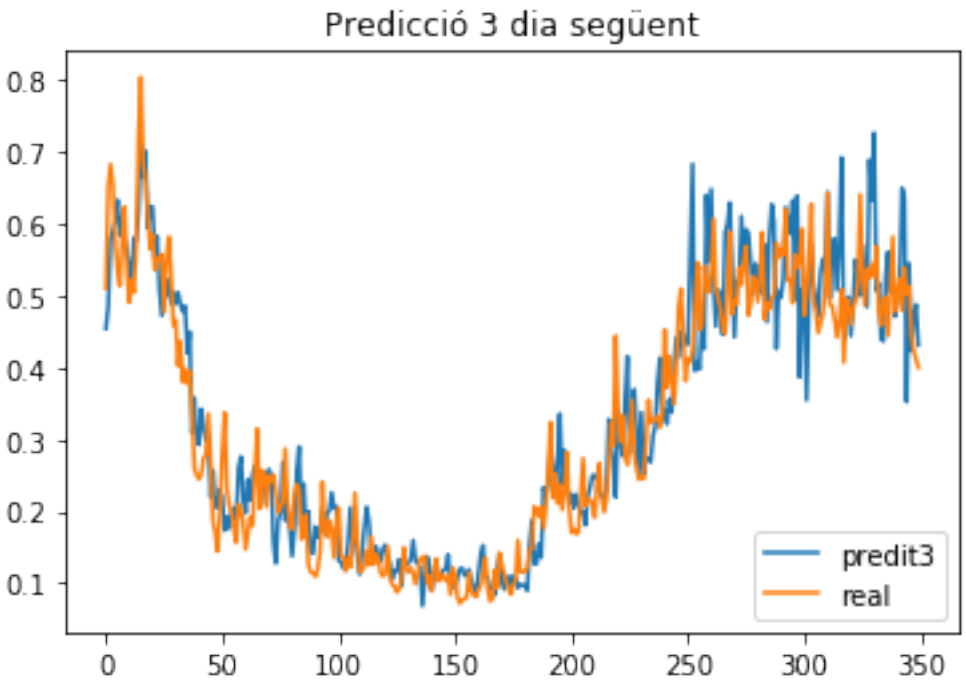
In [34]:
```
##Mostrem
plt.plot(predis[4], label="predit")
plt.plot(y_daily[n_train+4], label="real")
plt.legend(loc="lower right")
plt.show()
```

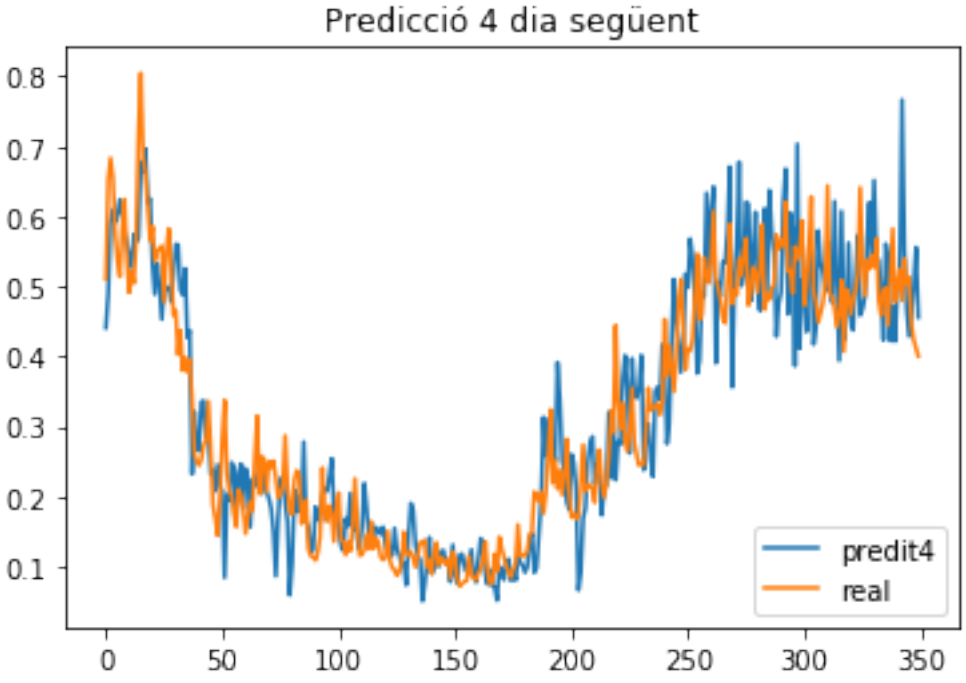


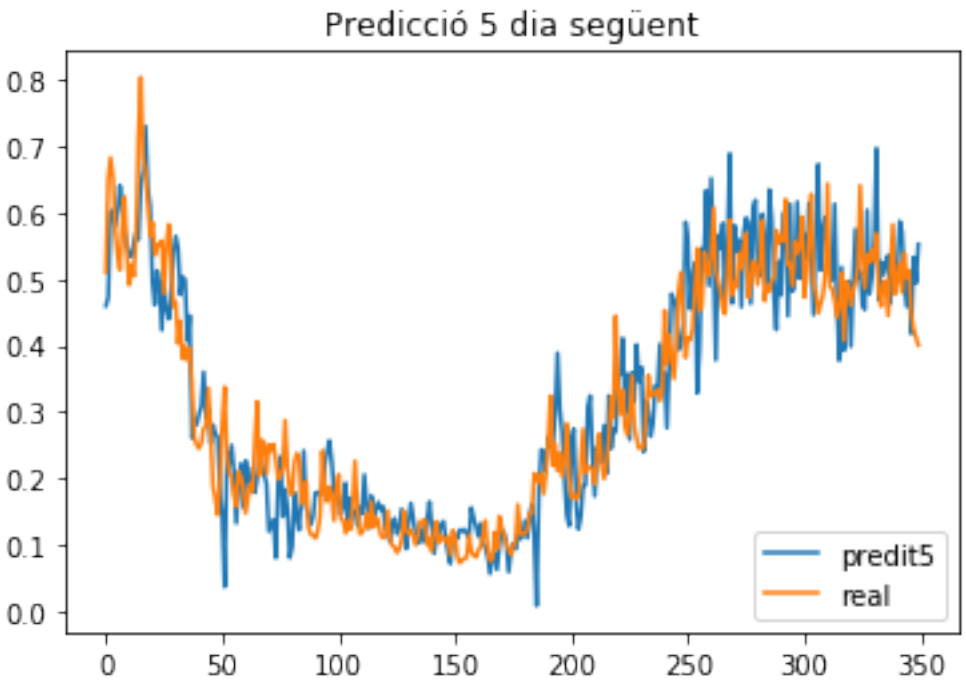
In [37]:
```
##Mostrem
plt.plot(llista_p0, label="predit1")
plt.plot(y_daily[n_train:lenght,0], label="real")
plt.legend(loc="lower right")
plt.title("Predicció 1 dia següent")
plt.show()

plt.plot(llista_p1, label="predit2")
plt.plot(y_daily[n_train:lenght,0], label="real")
plt.legend(loc="lower right")
plt.title("Predicció 2 dia següent")
plt.show()


plt.plot(llista_p2, label="predit3")
plt.plot(y_daily[n_train:lenght,0], label="real")
plt.legend(loc="lower right")
plt.title("Predicció 3 dia següent")
plt.show()

plt.plot(llista_p3, label="predit4")
plt.plot(y_daily[n_train:lenght,0], label="real")
plt.legend(loc="lower right")
plt.title("Predicció 4 dia següent")
plt.show()

plt.plot(llista_p4, label="predit5")
plt.plot(y_daily[n_train:lenght,0], label="real")
plt.legend(loc="lower right")
plt.title("Predicció 5 dia següent")
plt.show()

plt.plot(llista_p5, label="predit6")
plt.plot(y_daily[n_train:lenght,0], label="real")
plt.legend(loc="lower right")
plt.title("Predicció 6 dia següent")
plt.show()

plt.plot(llista_p6, label="predit6")
plt.plot(y_daily[n_train:lenght,0], label="real")
plt.legend(loc="lower right")
plt.title("Predicció 6 dia següent")
plt.show()
```

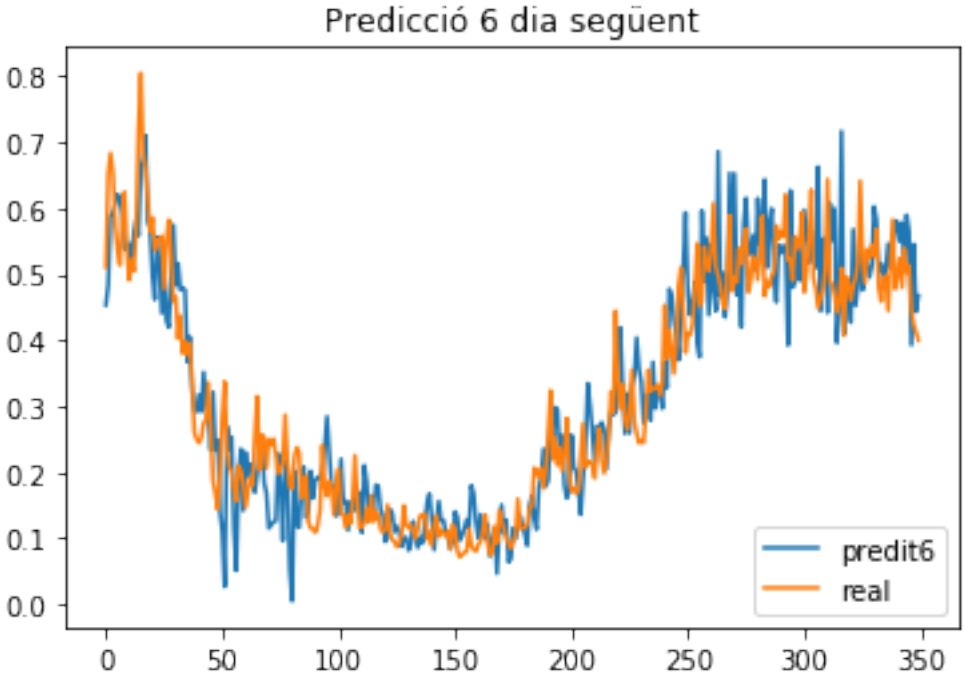

Predicció 1 dia següent
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
300
350
predit1
real

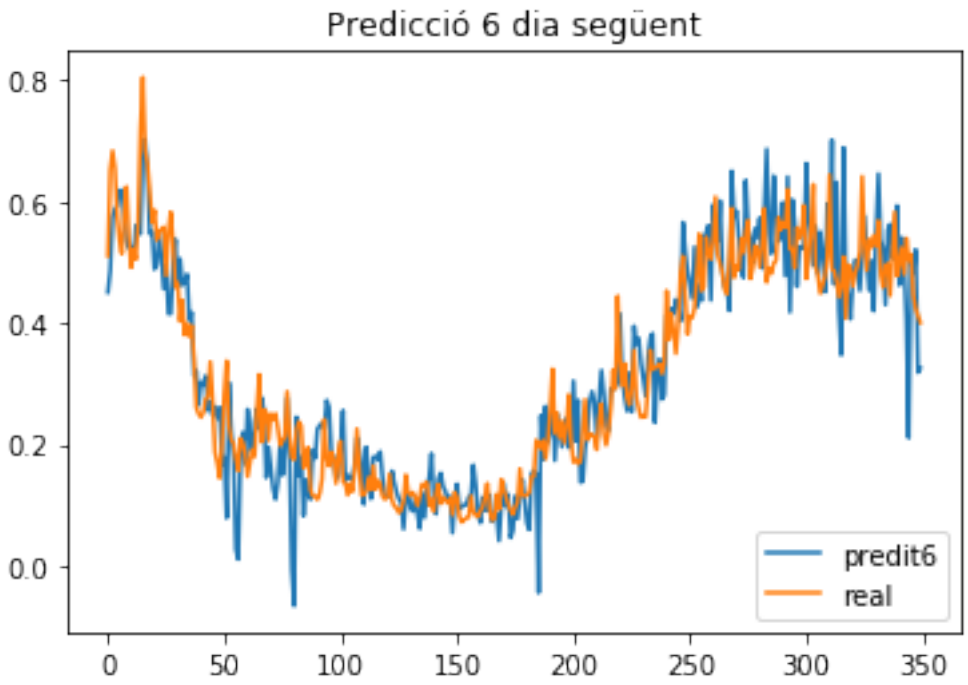

Predicció 2 dia següent
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
300
350
predit2
real


Predicció 3 dia següent
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
300
350
predit3
real


Predicció 4 dia següent
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
300
350
predit4
real


Predicció 5 dia següent
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
50
100
150
200
250
300
350
predit5
real


Predicció 6 dia següent
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
50
100
150
200
250
300
350
predit6
real


Predicció 6 dia següent
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300
350
predit6
real

In [ ]:

In [ ]: