Nour2

January 25, 2023

1 import libraries

[95]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import random
from sklearn.metrics import classification_report, confusion_matrix, roc_curve,␣
  ↪mean_squared_error, accuracy_score, recall_score, precision_score, f1_score
from sklearn.metrics import roc_auc_score, mean_absolute_error, make_scorer,␣
  ↪r2_score
from sklearn.model_selection import cross_val_score, train_test_split, KFold,␣
  ↪RandomizedSearchCV, GridSearchCV
from sklearn.linear_model import Lasso
from sklearn.tree import DecisionTreeClassifier
from sklearn.preprocessing import OneHotEncoder
from sklearn.compose import make_column_transformer
from sklearn.ensemble import GradientBoostingClassifier
from pipetorch import DFrame
from sklearn.svm import SVC, SVR, LinearSVC
from sklearn.linear_model import LinearRegression, LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from math import sqrt
from scipy import stats
from seaborn import load_dataset, pairplot
from sklearn import tree
from sklearn.ensemble import RandomForestRegressor, RandomForestClassifier
from pipetorch.evaluate.study import Study, optuna
import time
from datetime import datetime, timezone
from sklearn.linear_model import Ridge
import statsmodels.tsa.stattools as sts

from sklearn.preprocessing import LabelEncoder, PolynomialFeatures
from tensorflow.keras.preprocessing.sequence import pad_sequences
import re
from IPython.display import display
import os
```

```
from tensorflow.keras.datasets import imdb
from tensorflow.keras.models import Sequential, Model, load_model, save_model
from tensorflow.keras.callbacks import ModelCheckpoint, ReduceLROnPlateau,␣
  ↪EarlyStopping
from tensorflow.keras.layers import Dense, Activation, Dropout, Input, Masking,␣
  ↪TimeDistributed, LSTM, Conv1D, Embedding
from tensorflow.keras.layers import GRU, Bidirectional, BatchNormalization,␣
  ↪Reshape, Multiply, Dot, Concatenate
from tensorflow.keras import optimizers
from tensorflow.keras.optimizers import Adam
```

[2]:

```
pip install openpyxl
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: openpyxl in
/home/19015046/.local/lib/python3.9/site-packages (3.0.10)
Requirement already satisfied: et-xmlfile in
/home/19015046/.local/lib/python3.9/site-packages (from openpyxl) (1.1.0)
Note: you may need to restart the kernel to use updated packages.
```

[3]:

```
!ls /data/energie
```

```
001.xlsx  019.xlsx  037.xlsx  055.xlsx  073.xlsx  091.xlsx  109.xlsx
002.xlsx  020.xlsx  038.xlsx  056.xlsx  074.xlsx  092.xlsx  110.xlsx
003.xlsx  021.xlsx  039.xlsx  057.xlsx  075.xlsx  093.xlsx  111.xlsx
004.xlsx  022.xlsx  040.xlsx  058.xlsx  076.xlsx  094.xlsx  112.xlsx
005.xlsx  023.xlsx  041.xlsx  059.xlsx  077.xlsx  095.xlsx  113.xlsx
006.xlsx  024.xlsx  042.xlsx  060.xlsx  078.xlsx  096.xlsx  114.xlsx
007.xlsx  025.xlsx  043.xlsx  061.xlsx  079.xlsx  097.xlsx  115.xlsx
008.xlsx  026.xlsx  044.xlsx  062.xlsx  080.xlsx  098.xlsx  116.xlsx
009.xlsx  027.xlsx  045.xlsx  063.xlsx  081.xlsx  099.xlsx  117.xlsx
010.xlsx  028.xlsx  046.xlsx  064.xlsx  082.xlsx  100.xlsx  118.xlsx
011.xlsx  029.xlsx  047.xlsx  065.xlsx  083.xlsx  101.xlsx  119.xlsx
012.xlsx  030.xlsx  048.xlsx  066.xlsx  084.xlsx  102.xlsx  120.xlsx
013.xlsx  031.xlsx  049.xlsx  067.xlsx  085.xlsx  103.xlsx  unit_list.xlsx
014.xlsx  032.xlsx  050.xlsx  068.xlsx  086.xlsx  104.xlsx
015.xlsx  033.xlsx  051.xlsx  069.xlsx  087.xlsx  105.xlsx
016.xlsx  034.xlsx  052.xlsx  070.xlsx  088.xlsx  106.xlsx
017.xlsx  035.xlsx  053.xlsx  071.xlsx  089.xlsx  107.xlsx
018.xlsx  036.xlsx  054.xlsx  072.xlsx  090.xlsx  108.xlsx
```

2 De te gebruiken huisjes

```
[167]: wel_gebruiken= [1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16, 17, 19, 20, 22,␣
         ↪23, 24, 26, 28, 30, 37,
       38, 39, 40, 41, 42, 43, 44, 46, 47, 48, 50, 51, 52, 54, 55, 56, 57, 58, 60, 61,␣
         ↪63, 64, 66, 67, 69, 70,
       71, 72, 73, 74, 75, 76, 77, 79, 80, 81, 83, 84, 88, 91, 92, 93, 94, 95, 98, 99,␣
         ↪100, 102, 104, 105, 106,
       110, 112, 113, 114, 115, 116, 117, 120]
```

3 Functie voor huisjes

Hier heb ik een functie voor het inladen van alle huisjes

Ik heb dus een kolom gemaakt met de dag en de maand van het jaar. Daarnaast heb ik het energeiverbruik stationaire gemaakt

```
[244]: def huisje(huis_nr):
           huis = pd.read_csv(huis_nr, index_col=0)
           huis.index = pd.to_datetime(huis.index, errors='coerce')
           huis['datum'] = huis.index
           huis['perdag_verbruik_st']= huis['perdag_verbruik'].diff()
           huis['maand'] = huis['datum'].dt.strftime('%m')
           huis['dag']= [*range(1, len(huis)+1)]
           huis= huis[['dag', 'maand', 'perdag_verbruik', 'perdag_verbruik_st']].
         ↪fillna(0)
           huis= huis[:-1]
           return huis
```

4 Datasets inladen

```
[340]: huis1= huisje('df01_perdag')
       huis2= huisje('df02_perdag')
       huis3= huisje('df03_perdag')
       huis4= huisje('df04_perdag')
       huis5= huisje('df05_perdag')
       huis6= huisje('df06_perdag')
       huis7= huisje('df07_perdag')
       huis9= huisje('df09_perdag')
       huis10= huisje('df010_perdag')
       huis11= huisje('df011_perdag')
       huis12= huisje('df012_perdag')
       huis14= huisje('df014_perdag')
```

```
huis15= huisje('df015_perdag')
huis16= huisje('df016_perdag')
huis17= huisje('df017_perdag')
huis19= huisje('df019_perdag')
huis20= huisje('df020_perdag')
huis22= huisje('df022_perdag')
huis23= huisje('df023_perdag')
huis24= huisje('df024_perdag')
huis26= huisje('df026_perdag')
huis28= huisje('df028_perdag')
huis30= huisje('df030_perdag')
huis37= huisje('df037_perdag')
huis38= huisje('df038_perdag')
huis39= huisje('df039_perdag')
huis40= huisje('df040_perdag')
huis41= huisje('df041_perdag')
huis42= huisje('df042_perdag')
huis43= huisje('df043_perdag')
huis44= huisje('df044_perdag')
huis46= huisje('df046_perdag')
huis47= huisje('df047_perdag')
huis48= huisje('df048_perdag')
huis50= huisje('df050_perdag')
huis51= huisje('df01_perdag')
huis52= huisje('df01_perdag')
huis54= huisje('df01_perdag')
huis55= huisje('df01_perdag')
huis56= huisje('df01_perdag')
huis57= huisje('df01_perdag')
huis58= huisje('df058_perdag')
huis60= huisje('df060_perdag')
huis61= huisje('df061_perdag')
huis63= huisje('df063_perdag')
huis64= huisje('df064_perdag')
huis66= huisje('df066_perdag')
huis67= huisje('df067_perdag')
huis69= huisje('df069_perdag')
huis70= huisje('df070_perdag')
huis71= huisje('df071_perdag')
huis72= huisje('df072_perdag')
huis73= huisje('df073_perdag')
huis74= huisje('df074_perdag')
huis75= huisje('df075_perdag')
huis76= huisje('df076_perdag')
huis77= huisje('df077_perdag')
huis79= huisje('df079_perdag')
huis80= huisje('df080_perdag')
```

```
huis81= huisje('df081_perdag')
huis83= huisje('df083_perdag')
huis84= huisje('df084_perdag')
huis88= huisje('df088_perdag')
huis91= huisje('df091_perdag')
huis92= huisje('df092_perdag')
huis93= huisje('df093_perdag')
huis94= huisje('df094_perdag')
huis95= huisje('df095_perdag')
huis98= huisje('df098_perdag')
huis99= huisje('df099_perdag')
huis100= huisje('df0100_perdag')
huis102= huisje('df0102_perdag')
huis104= huisje('df0104_perdag')
huis105= huisje('df0105_perdag')
huis106= huisje('df0106_perdag')
huis110= huisje('df0110_perdag')
huis112= huisje('df0112_perdag')
huis113= huisje('df0113_perdag')
huis114= huisje('df0114_perdag')
huis115= huisje('df0115_perdag')
huis116= huisje('df0116_perdag')
huis117= huisje('df0117_perdag')
huis120= huisje('df0120_perdag')
```

5 verbruik per dag visualiseren

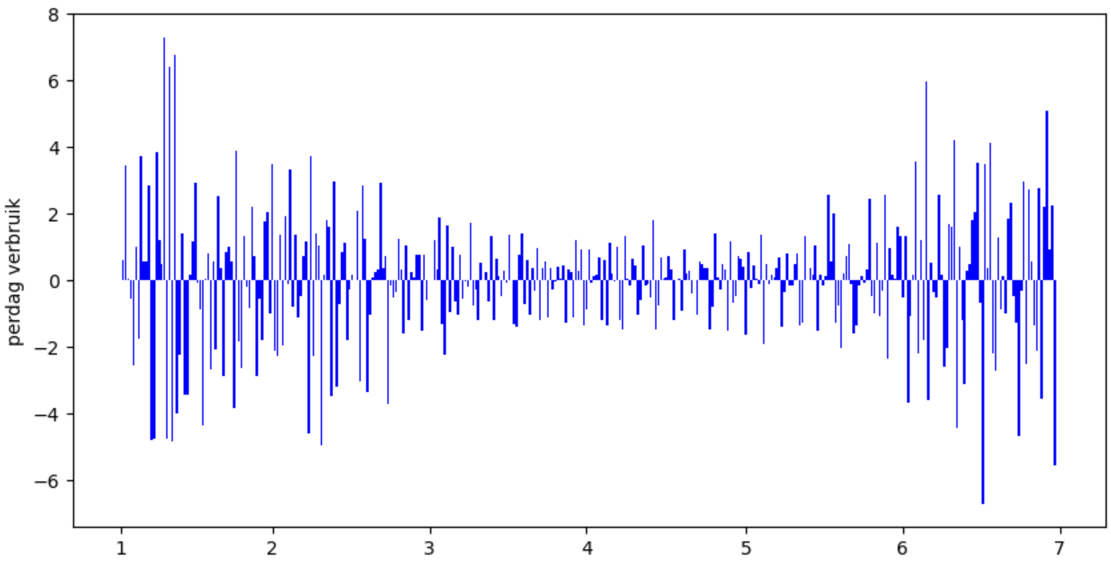
[281]:

```
fig, ax= plt.subplots(figsize=(10,5))
ax.bar(huis26.index, huis26.perdag_verbruik_st, color='blue')
ax.set_xticklabels(huis26['dag'])
ax.set_ylabel('perdag verbruik')
```

```
/tmp/ipykernel_43694/555732226.py:3: UserWarning: FixedFormatter should only be
used together with FixedLocator
  ax.set_xticklabels(huis26['dag'])
```

[281]:

```
Text(0, 0.5, 'perdag verbruik')
```



6 Weerdata inlezen en dan mergen met de dataset

[341]:
```
weer = pd.read_csv('KNMI.txt')
weer= weer[weer['YYYYMMDD'] >20181231]
weer= weer[weer['YYYYMMDD'] <20200101]
weer['datum'] = weer['YYYYMMDD'].apply(lambda x: pd.to_datetime(str(x),␣
  ↪format='%Y-%m-%d'))
weer= weer[['datum', '    Q']]
weer.columns= ['datum', 'zonsterkte']
weer= weer.set_index('datum')
weer
```

[341]:
```
            zonsterkte
datum
2019-01-01         161
2019-01-02         147
2019-01-03         257
2019-01-04          49
2019-01-05          56
…                  …
2019-12-27         334
2019-12-28         235
2019-12-29         199
2019-12-30         362
2019-12-31         303
```

```
[365 rows x 1 columns]
```

[343]:

```
huis26['datum'] = pd.to_datetime(huis26.index, errors='coerce')
huis26= huis26.merge(weer, on='datum', how='inner')
huis26= huis26.set_index('datum')
huis26= huis26[['dag', 'maand', 'zonsterkte', 'perdag_verbruik',␣
 ↪'perdag_verbruik_st']]
huis26
```

[343]:

```
            dag maand zonsterkte  perdag_verbruik  perdag_verbruik_st
datum
2019-01-01    1    01        161           9.0395              0.0000
2019-01-02    2    01        147           9.6430              0.6035
2019-01-03    3    01        257          13.0820              3.4390
2019-01-04    4    01         49          13.1460              0.0640
2019-01-05    5    01         56          12.5870             -0.5590
…           …   …         …              …                  …
2019-12-27  361    12        334          14.1130              5.0840
2019-12-28  362    12        235          15.0320              0.9190
2019-12-29  363    12        199          17.2900              2.2580
2019-12-30  364    12        362          11.7260             -5.5640
2019-12-31  365    12        303           0.0000              0.0000

[365 rows x 5 columns]
```

voor het voorspellen van energieverbruik heb ik verschillende modellen uitgeprobeerd.

Omdat dit met tijdreeksen te maken heeft, kunnen wij sws geen classificatie modellen gebruiken. De modellen die van toepassing zijn voor dit soort probleem zijn: Linear Regression, Polynomial Features, Support Vector Regression en LSTM.

In dit notebook zijn Linear Regression, Polynomial Features en Support Vector Regression toegepast op huis 26. De modellen heb ik getraind op normale en stationaire data om te kijken waarop de beste resultaten komen.

7 Linear Regression

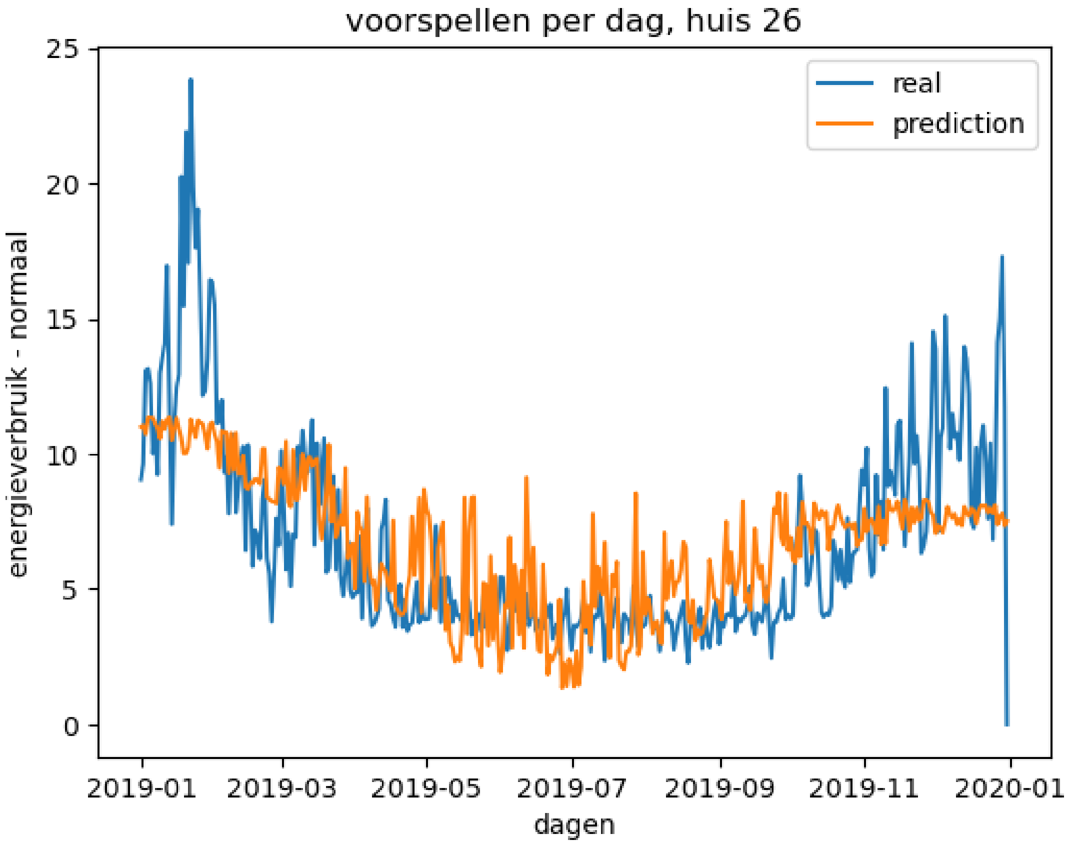
trainen op normale data

[351]:

```
lr= LinearRegression()
X= huis26[['zonsterkte', 'dag', 'maand']].values
y= huis26['perdag_verbruik'].values
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=100)
lr.fit(X_train, y_train)
prediction= lr.predict(X_test)
score= lr.score(X_test, y_test)
```

```
validation_error = sqrt(mean_squared_error(prediction, y_test))

plt.title('voorspellen per dag, huis 26')
plt.plot(huis26.index, y, label='real')
plt.plot(huis26.index, lr.predict(X), label='prediction')
plt.xlabel('dagen')
plt.ylabel('energieverbruik - normaal')
plt.legend()

print('model score: ', score)
print('validation error: ', validation_error)
print('intercept: ', lr.intercept_)
print('coefficients: ', lr.coef_)
```

```
model score:  0.4822308975951086
validation error:  2.8933965189240305
intercept:  12.018539619232811
coefficients:  [-0.00293397  0.00846628 -0.55850282]
```

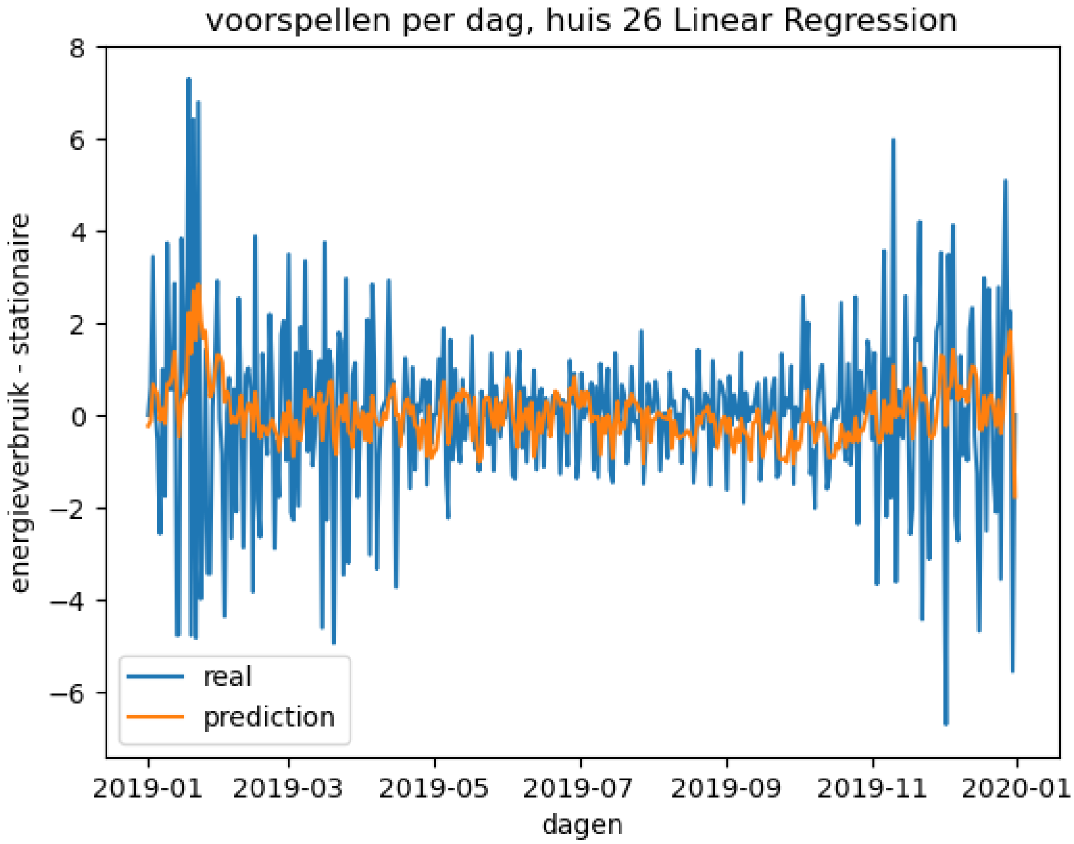


trainen op stationaire data

[350]:

```
lr= LinearRegression()
X= huis26.drop('perdag_verbruik_st', axis=1).values
y= huis26['perdag_verbruik_st'].values
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
  ↪random_state=100)
lr.fit(X_train, y_train)
prediction= lr.predict(X_test)
score= lr.score(X_test, y_test)
validation_error = sqrt(mean_squared_error(prediction, y_test))

plt.title('voorspellen per dag, huis 26 Linear Regression')
plt.plot(huis26.index, y, label='real')
plt.plot(huis26.index, lr.predict(X), label='prediction')
plt.xlabel('dagen')
plt.ylabel('energieverbruik - stationaire')
plt.legend()

print('model score: ', score)
print('validation error: ', validation_error)
print('intercept: ', lr.intercept_)
print('coefficients: ', lr.coef_)
```

```
model score:  0.12580552259388444
validation error:  1.9726310937634108
intercept:  -2.3381350782589703
coefficients:  [-0.00177233  0.0848002   0.00063967  0.21179579]
```

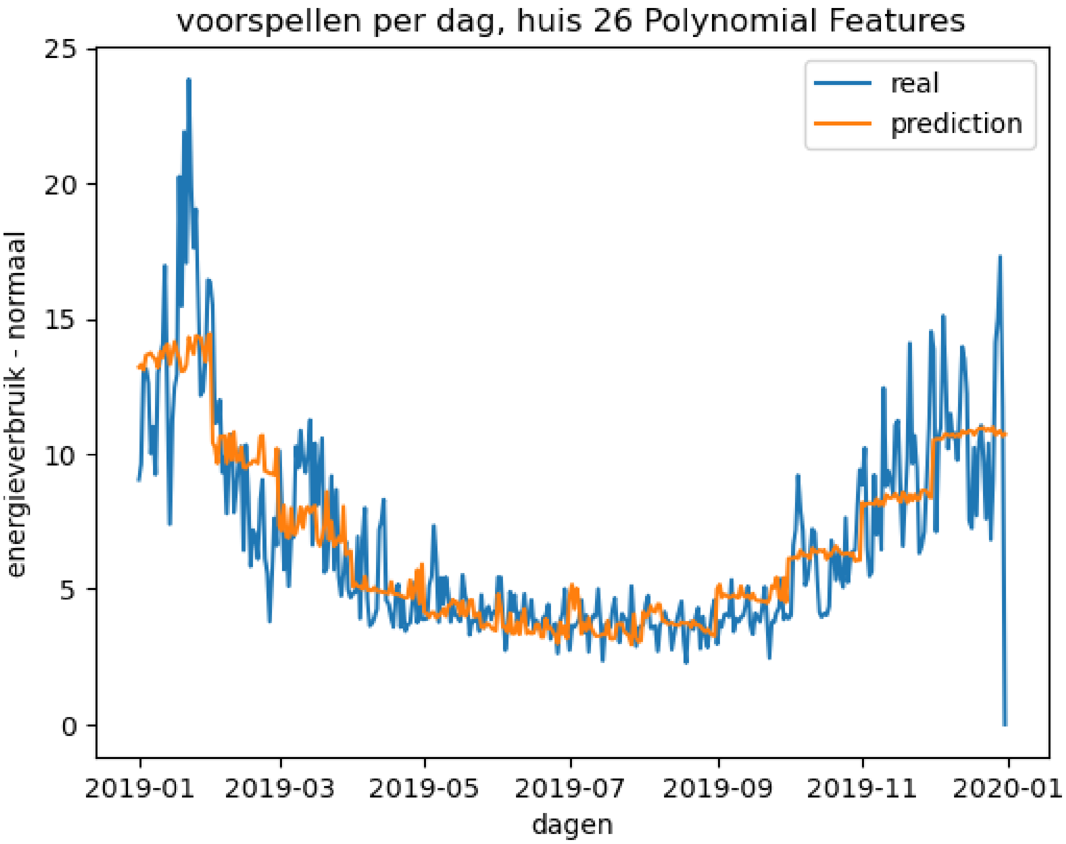


8 Polynomial Features

[349]:
```
X = huis26.iloc[:, :3].values
y = huis26.iloc[:, 3].values

lin_reg = LinearRegression()
lin_reg.fit(X,y)
poly_reg = PolynomialFeatures(degree=2)
X_poly = poly_reg.fit_transform(X)
lin_reg2 = LinearRegression()
lin_reg2.fit(X_poly, y)

print('score: ', lin_reg.score(X, y))

plt.plot(huis26.index, y, label='real')
plt.plot(huis26.index, lin_reg2.predict(X_poly), label='prediction')
plt.title('voorspellen per dag, huis 26 Polynomial Features')
plt.xlabel('dagen')
plt.ylabel('energieverbruik - normaal')
plt.legend()
```

```
score:  0.4616551182937678
```

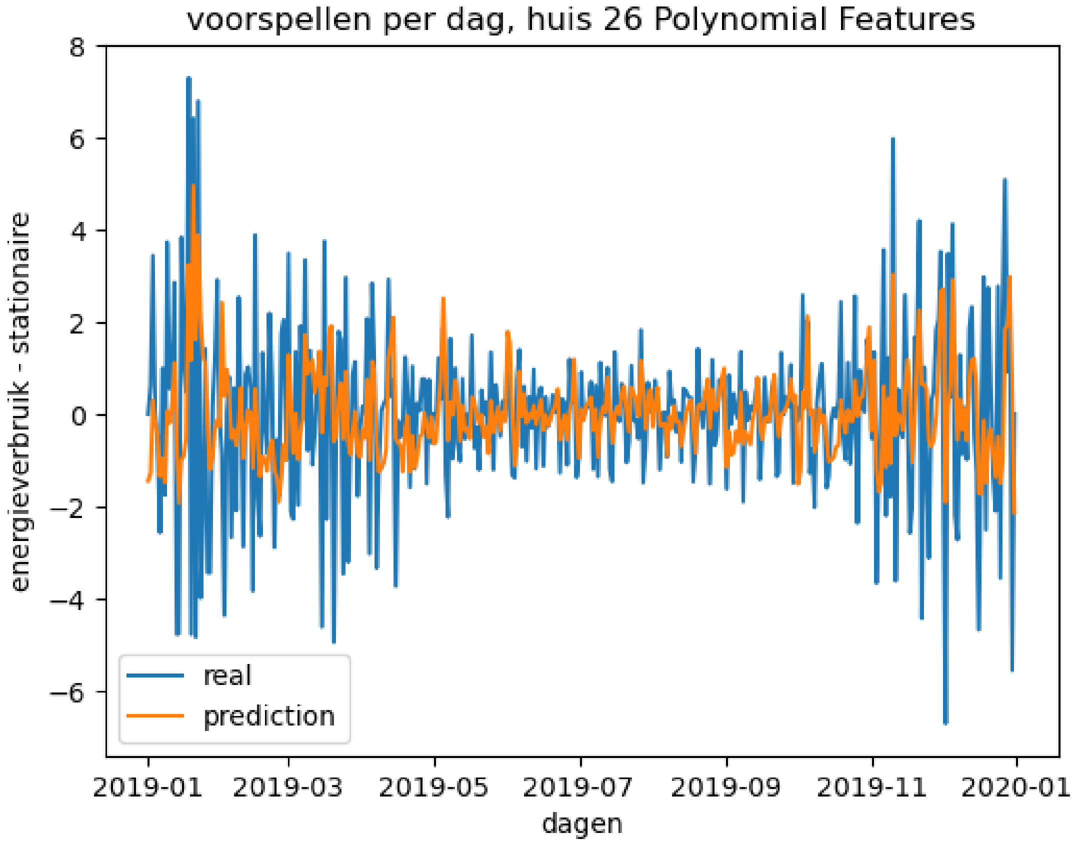
[349]:
```
<matplotlib.legend.Legend at 0x7f52c4639f70>
```



[352]:
```
X = huis26.iloc[:, :4].values
y = huis26.iloc[:, 4].values

lin_reg = LinearRegression()
lin_reg.fit(X,y)
poly_reg = PolynomialFeatures(degree=2)
X_poly = poly_reg.fit_transform(X)
lin_reg2 = LinearRegression()
lin_reg2.fit(X_poly, y)

print('score: ', lin_reg.score(X, y))

plt.plot(huis26.index, y, label='real')
plt.plot(huis26.index, lin_reg2.predict(X_poly), label='prediction')
plt.title('voorspellen per dag, huis 26 Polynomial Features')
plt.xlabel('dagen')
plt.ylabel('energieverbruik - stationaire')
plt.legend()
```

```
score:  0.1186912566596422
```

[352]:
```
<matplotlib.legend.Legend at 0x7f52c44da850>
```



9 per uur proberen te voorspellen

[356]:
```
df26uur= pd.read_csv('df026_per1uur', index_col=0)
df26uur['datum']= df26uur.index
df26uur= df26uur[['datum', 'perdag_verbruik']]
df26uur['datum'] = pd.to_datetime(df26uur.index, errors='coerce')
df26uur['maand'] = df26uur['datum'].dt.strftime('%m')
df26uur = df26uur[['datum', 'maand', 'perdag_verbruik']]
```

```
df26uur
```

[356]:

```
                                      datum maand  perdag_verbruik
2019-01-01 00:00:00 2019-01-01 00:00:00    01           0.4895
2019-01-01 01:00:00 2019-01-01 01:00:00    01           1.2425
2019-01-01 02:00:00 2019-01-01 02:00:00    01           0.1390
2019-01-01 03:00:00 2019-01-01 03:00:00    01           0.1375
2019-01-01 04:00:00 2019-01-01 04:00:00    01           0.1390
…                                     …   …                …
2019-12-31 20:00:00 2019-12-31 20:00:00    12           0.6065
2019-12-31 21:00:00 2019-12-31 21:00:00    12           0.6705
2019-12-31 22:00:00 2019-12-31 22:00:00    12           0.2400
2019-12-31 23:00:00 2019-12-31 23:00:00    12              NaN
2020-01-01 00:00:00 2020-01-01 00:00:00    01              NaN

[8761 rows x 3 columns]
```

[357]:

```
weer = pd.read_csv('KNMI.txt')
weer= weer[weer['YYYYMMDD'] >20181231]
weer= weer[weer['YYYYMMDD'] <20200101]
weer['datum'] = weer['YYYYMMDD'].apply(lambda x: pd.to_datetime(str(x),␣
 ↪format='%Y%m%d'))

weer= weer.set_index('datum')
weer['    Q'] = weer['    Q'].astype(int)
new_range = pd.date_range(np.datetime64('2019-01-01T00:00:00.000000000'), np.
 ↪datetime64('2020-01-01T00:00:00.000000000'), freq='1H')
weer_datum= weer.index
weerinterpol = weer.reindex(weer_datum.union(new_range)).
 ↪interpolate(method='linear', limit_direction='backward').loc[new_range]
weerinterpol['datum']= weerinterpol.index
weer2= weerinterpol[['datum', '    Q']]
weer2= weer2.rename({'    Q':'zonsterkte'}, axis=1)
weer2
```

[357]:

```
                                      datum  zonsterkte
2019-01-01 00:00:00 2019-01-01 00:00:00  161.000000
2019-01-01 01:00:00 2019-01-01 01:00:00  160.416667
2019-01-01 02:00:00 2019-01-01 02:00:00  159.833333
2019-01-01 03:00:00 2019-01-01 03:00:00  159.250000
2019-01-01 04:00:00 2019-01-01 04:00:00  158.666667
…                                     …          …
2019-12-31 20:00:00 2019-12-31 20:00:00         NaN
2019-12-31 21:00:00 2019-12-31 21:00:00         NaN
2019-12-31 22:00:00 2019-12-31 22:00:00         NaN
2019-12-31 23:00:00 2019-12-31 23:00:00         NaN
```

```
2020-01-01 00:00:00 2020-01-01 00:00:00         NaN

[8761 rows x 2 columns]
```

[358]:

```
df26uur= df26uur.merge(weer2, on='datum', how='inner').dropna()
df26uur= df26uur[['datum', 'maand', 'zonsterkte', 'perdag_verbruik']]
df26uur= df26uur.set_index('datum')
df26uur
```

[358]:

```
                    maand  zonsterkte  perdag_verbruik
datum
2019-01-01 00:00:00    01  161.000000           0.4895
2019-01-01 01:00:00    01  160.416667           1.2425
2019-01-01 02:00:00    01  159.833333           0.1390
2019-01-01 03:00:00    01  159.250000           0.1375
2019-01-01 04:00:00    01  158.666667           0.1390
…                     …          …               …
2019-12-30 20:00:00    12  312.833333           0.5700
2019-12-30 21:00:00    12  310.375000           0.8500
2019-12-30 22:00:00    12  307.916667           0.6310
2019-12-30 23:00:00    12  305.458333           0.0830
2019-12-31 00:00:00    12  303.000000           0.0760

[8737 rows x 3 columns]
```

[359]:

```
df26uur.isnull().sum()
```

[359]:

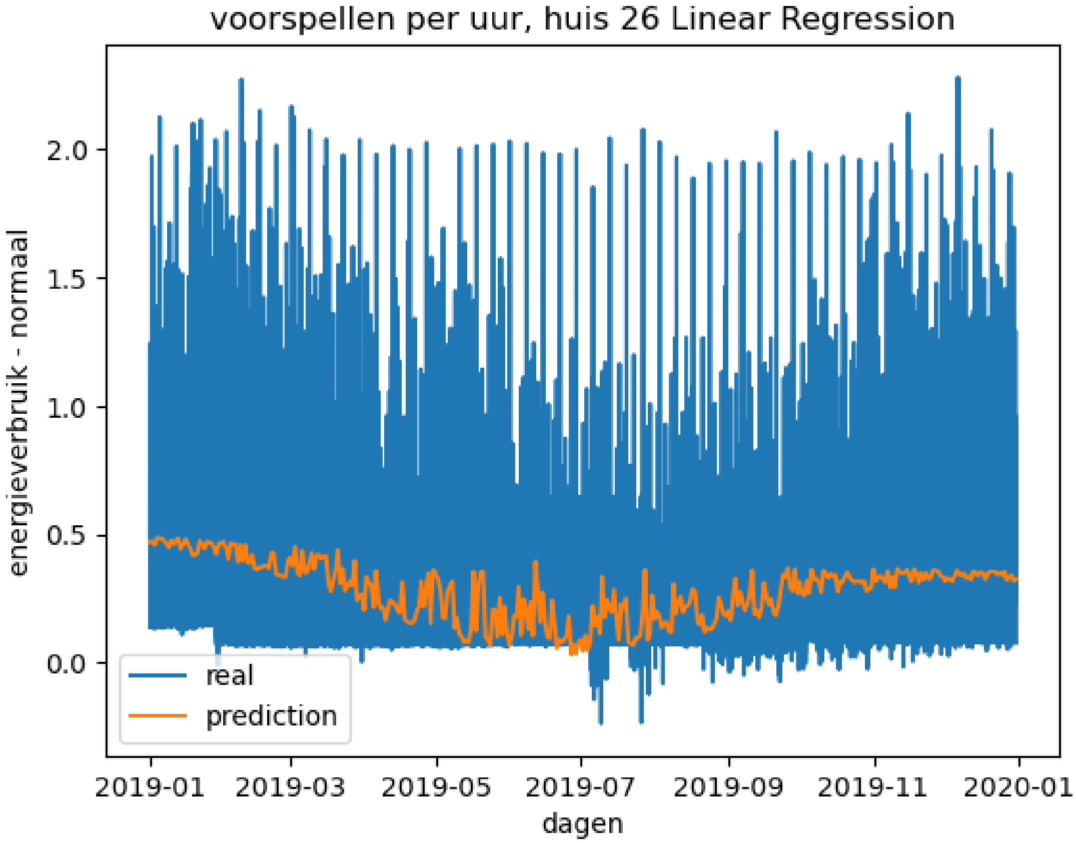
```
maand              0
zonsterkte         0
perdag_verbruik    0
dtype: int64
```

[361]:

```
X = df26uur[['maand', 'zonsterkte']].values
y = df26uur['perdag_verbruik'].values
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2,␣
 ↪random_state=42)
lr.fit(X_train, y_train)
y_pred = lr.predict(X_test)
score= lr.score(X_test, y_test)
validation_error = sqrt(mean_squared_error(y_pred, y_test))

plt.plot(df26uur.index, y, label='real')
plt.plot(df26uur.index, lr.predict(X), label='prediction')
plt.title('voorspellen per uur, huis 26 Linear Regression')
plt.xlabel('dagen')
plt.ylabel('energieverbruik - normaal')
plt.legend()
```

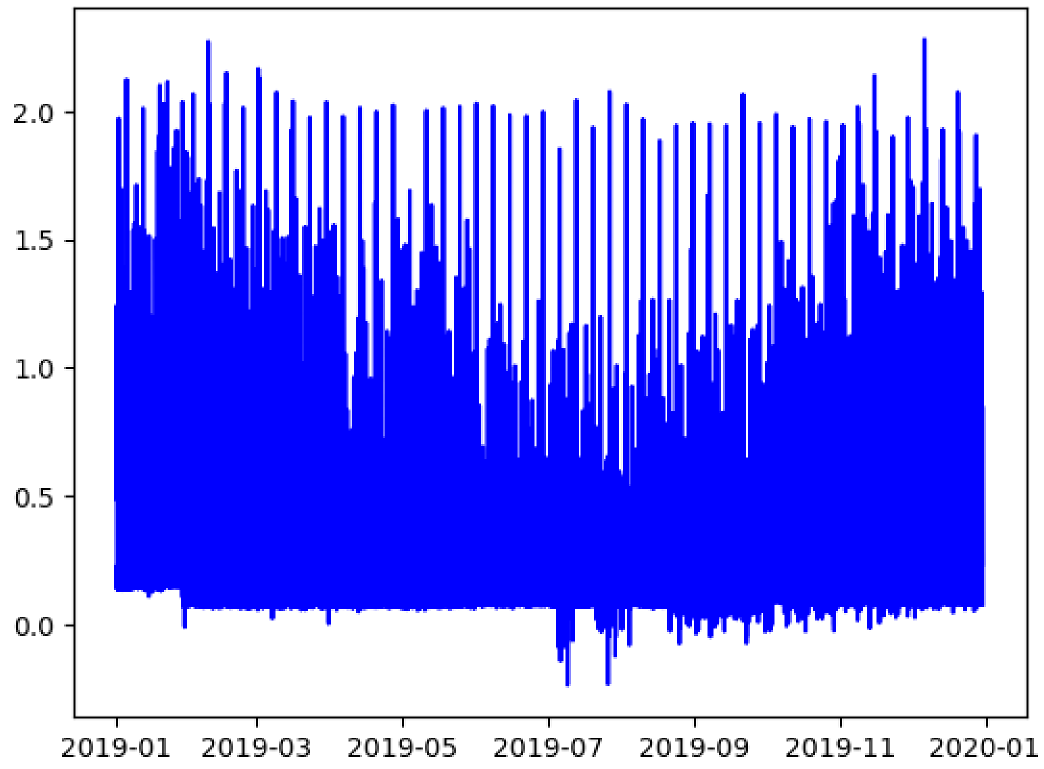
```
print('prediction: ', y_pred)
print('model score: ', score)
print('validation error: ', validation_error)
print('intercept: ', lr.intercept_)
print('coefficients: ', lr.coef_)
```

```
prediction:  [0.37511912 0.3977588  0.14782155 … 0.35600289 0.20481542
0.13352048]
model score:  0.10790427644396416
validation error:  0.33298137377570636
intercept:  0.5034861310056093
coefficients:  [-0.01145945 -0.00013407]
```



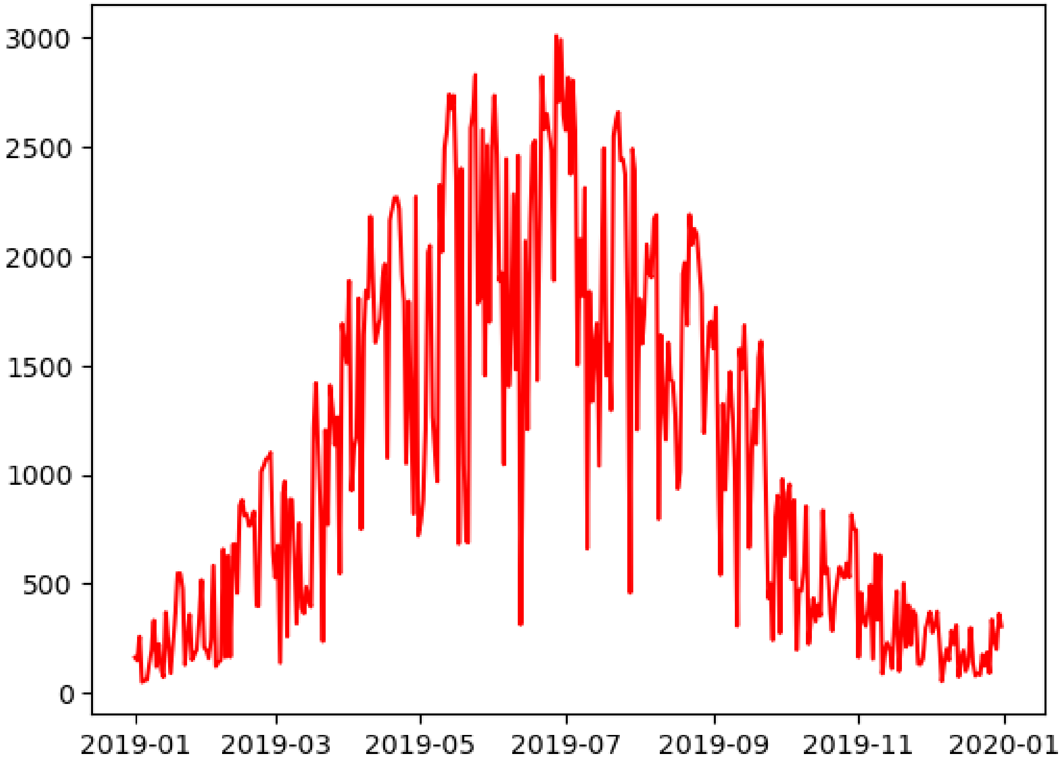
```
[362]: plt.plot(df26uur.index, df26uur['perdag_verbruik'], color='blue')
```

```
[362]: [<matplotlib.lines.Line2D at 0x7f52c40f8a90>]
```



```
[363]: plt.plot(df26uur.index, df26uur['zonsterkte'], color='red')
```

```
[363]: [<matplotlib.lines.Line2D at 0x7f52c3fc3d60>]
```



[364]:
```
from sklearn.preprocessing import StandardScaler
X= df26uur.iloc[:, 0:2].values
y= df26uur.iloc[:, 2].values
y= y.reshape(-1,1)
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2,␣
 ↪random_state=42)

sc_X = StandardScaler()
sc_y = StandardScaler()
X = sc_X.fit_transform(X)
y = sc_y.fit_transform(y)
```

[365]:
```
from sklearn.svm import SVR
regressor = SVR(kernel = 'rbf')
regressor.fit(X, y)
```

```
/opt/jupyterhub/anaconda/lib/python3.9/site-
packages/sklearn/utils/validation.py:1111: DataConversionWarning: A column-
vector y was passed when a 1d array was expected. Please change the shape of y
to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

[365]:
```
SVR()
```

[366]:
```
y_pred = regressor.predict(X_test)
y_pred= y_pred.reshape(-1,1)
y_pred = sc_y.inverse_transform(y_pred)
y_pred
```

[366]:
```
array([[0.19729138],
       [0.19729138],
       [0.19729138],
       …,
       [0.19729138],
       [0.19729138],
       [0.19729138]])
```

[367]:
```
regressor.score(X_test, y_test)
```

[367]:
```
-2.3178829019910365
```

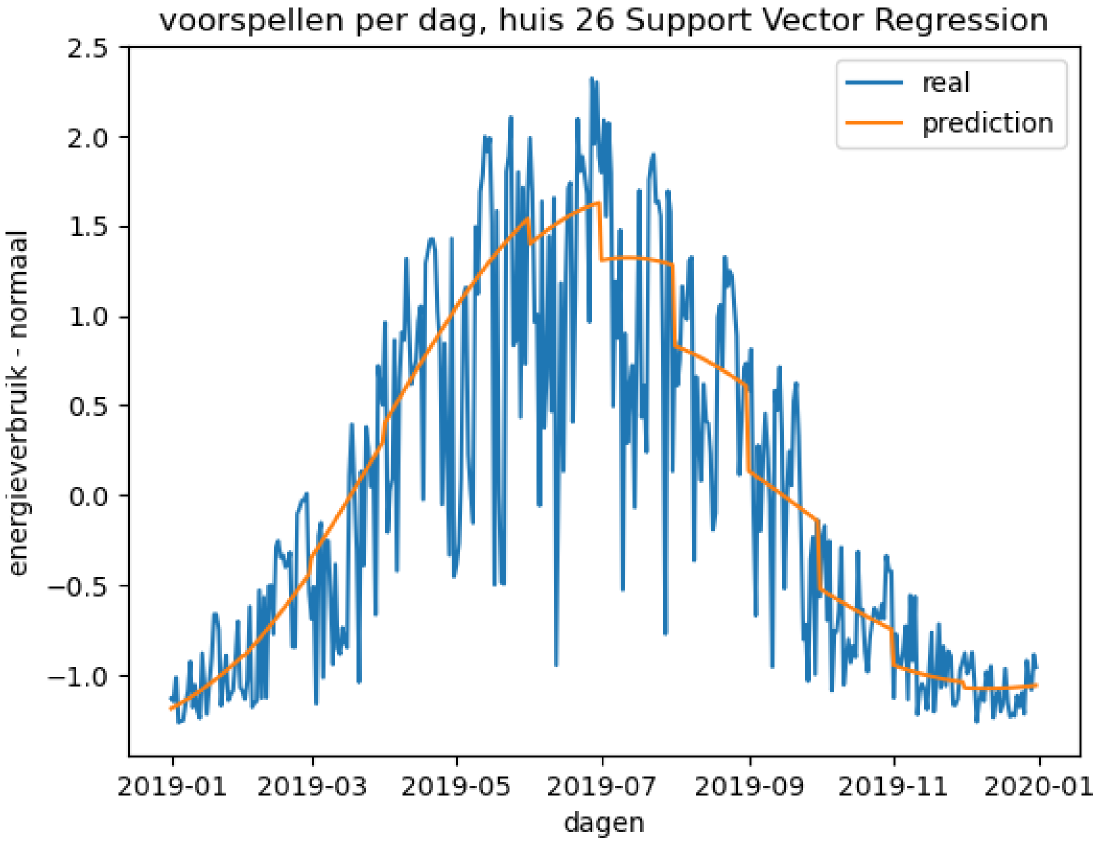
10 Support Vector Regression

[368]:
```
X= huis26.iloc[:, :2].values
y= huis26.iloc[:, 2].values
y= y.reshape(-1, 1)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)

sc_X = StandardScaler()
sc_y = StandardScaler()
X = sc_X.fit_transform(X)
y = sc_y.fit_transform(y)
```

[369]:
```
regressor = SVR(kernel = 'rbf')
regressor.fit(X, y)
y_pred = regressor.predict(X_test).reshape(-1,1)
y_pred = sc_y.inverse_transform(y_pred)
score= regressor.score(X_test, y_test)
mse= mean_squared_error(y, regressor.predict(X))
validation_error = sqrt(mean_squared_error(y_pred, y_test))

plt.plot(huis26.index, y, label='real')
plt.plot(huis26.index, regressor.predict(X), label='prediction')
plt.title('voorspellen per dag, huis 26 Support Vector Regression')
plt.xlabel('dagen')
plt.ylabel('energieverbruik - normaal')
plt.legend()

print('model score: ', score)
print('mean squared error: ', mse)
print('validation error: ', validation_error)
```

```
model score:  -1.6258024204184087
mean squared error:  0.2928820271594056
validation error:  743.2701782163771
```

```
/opt/jupyterhub/anaconda/lib/python3.9/site-
packages/sklearn/utils/validation.py:1111: DataConversionWarning: A column-
vector y was passed when a 1d array was expected. Please change the shape of y
to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```



11 Polynomial Features

[370]:

```
lr26= LinearRegression()
X= huis26.drop('perdag_verbruik_st', axis=1).values
y= huis26['perdag_verbruik_st'].values
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
  ↪random_state=100)
lr26.fit(X_train, y_train)
prediction= lr26.predict(X_test)
score= lr26.score(X_test, y_test)
print('model score: ', score)

poly = PolynomialFeatures(degree = 6)
X_poly = poly.fit_transform(X)
poly.fit(X_poly, y)

lin2 = LinearRegression()
lin2.fit(X_poly, y)

predict_lin = lr26.predict(X)
predict_lin2 = lin2.predict(poly.fit_transform(X))

mse= mean_squared_error(y, predict_lin2)

print('mean squared error: ', mse)
```

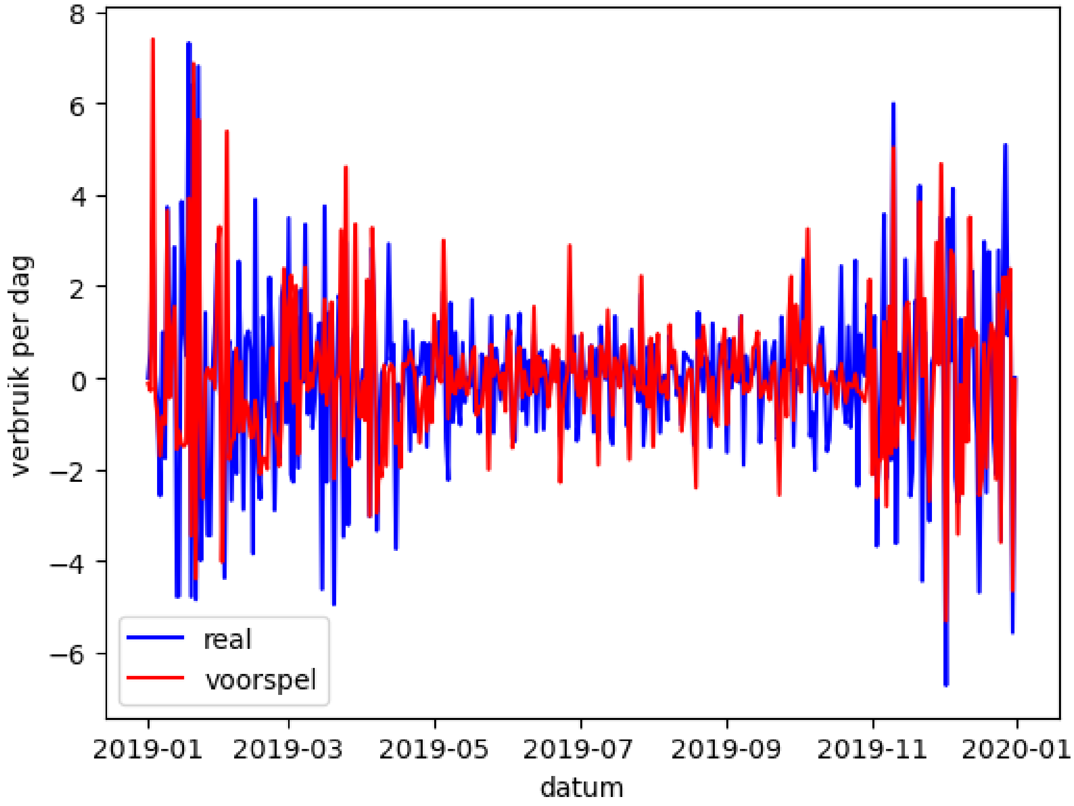
```
model score:  0.12580552259388444
mean squared error:  1.968473734802207
```

[371]:

```
plt.plot(huis26.index, y, color='blue', label='real')
plt.plot(huis26.index, predict_lin2, color='red', label='voorspel')
plt.xlabel('datum')
plt.ylabel('verbruik per dag')
plt.legend()
```

[371]:

```
<matplotlib.legend.Legend at 0x7f52c3f19550>
```



12 huis 26 voorspellen, met dummies

met stationaire data

```
[287]: huis026= pd.get_dummies(huis26.loc[:,['maand', 'dag']], columns = ['maand',␣
         ↪'dag'])
       huis026= pd.concat([huis026, huis26.loc[:,['perdag_verbruik_st']]], axis=1)
```

```
[383]: huis026
```

```
[383]:             maand_01  maand_02  maand_03  maand_04  maand_05  maand_06  \
       datum
       2019-01-01         1         0         0         0         0         0
       2019-01-02         1         0         0         0         0         0
       2019-01-03         1         0         0         0         0         0
       2019-01-04         1         0         0         0         0         0
       2019-01-05         1         0         0         0         0         0
       …                …       …       …       …       …       …
       2019-12-27         0         0         0         0         0         0
```

```
2019-12-28         0         0         0         0         0         0
2019-12-29         0         0         0         0         0         0
2019-12-30         0         0         0         0         0         0
2019-12-31         0         0         0         0         0         0

            maand_07  maand_08  maand_09  maand_10  …  dag_357  dag_358  \
datum                                               …
2019-01-01         0         0         0         0  …        0        0
2019-01-02         0         0         0         0  …        0        0
2019-01-03         0         0         0         0  …        0        0
2019-01-04         0         0         0         0  …        0        0
2019-01-05         0         0         0         0  …        0        0
…              …       …       …       …  …      …      …
2019-12-27         0         0         0         0  …        0        0
2019-12-28         0         0         0         0  …        0        0
2019-12-29         0         0         0         0  …        0        0
2019-12-30         0         0         0         0  …        0        0
2019-12-31         0         0         0         0  …        0        0

            dag_359  dag_360  dag_361  dag_362  dag_363  dag_364  dag_365  \
datum
2019-01-01        0        0        0        0        0        0        0
2019-01-02        0        0        0        0        0        0        0
2019-01-03        0        0        0        0        0        0        0
2019-01-04        0        0        0        0        0        0        0
2019-01-05        0        0        0        0        0        0        0
…             …      …      …      …      …      …      …
2019-12-27        0        0        1        0        0        0        0
2019-12-28        0        0        0        1        0        0        0
2019-12-29        0        0        0        0        1        0        0
2019-12-30        0        0        0        0        0        1        0
2019-12-31        0        0        0        0        0        0        1

            perdag_verbruik_st
datum
2019-01-01              0.0000
2019-01-02              0.6035
2019-01-03              3.4390
2019-01-04              0.0640
2019-01-05             -0.5590
…                        …
2019-12-27              5.0840
2019-12-28              0.9190
2019-12-29              2.2580
2019-12-30             -5.5640
2019-12-31              0.0000
```

```
[365 rows x 378 columns]
```

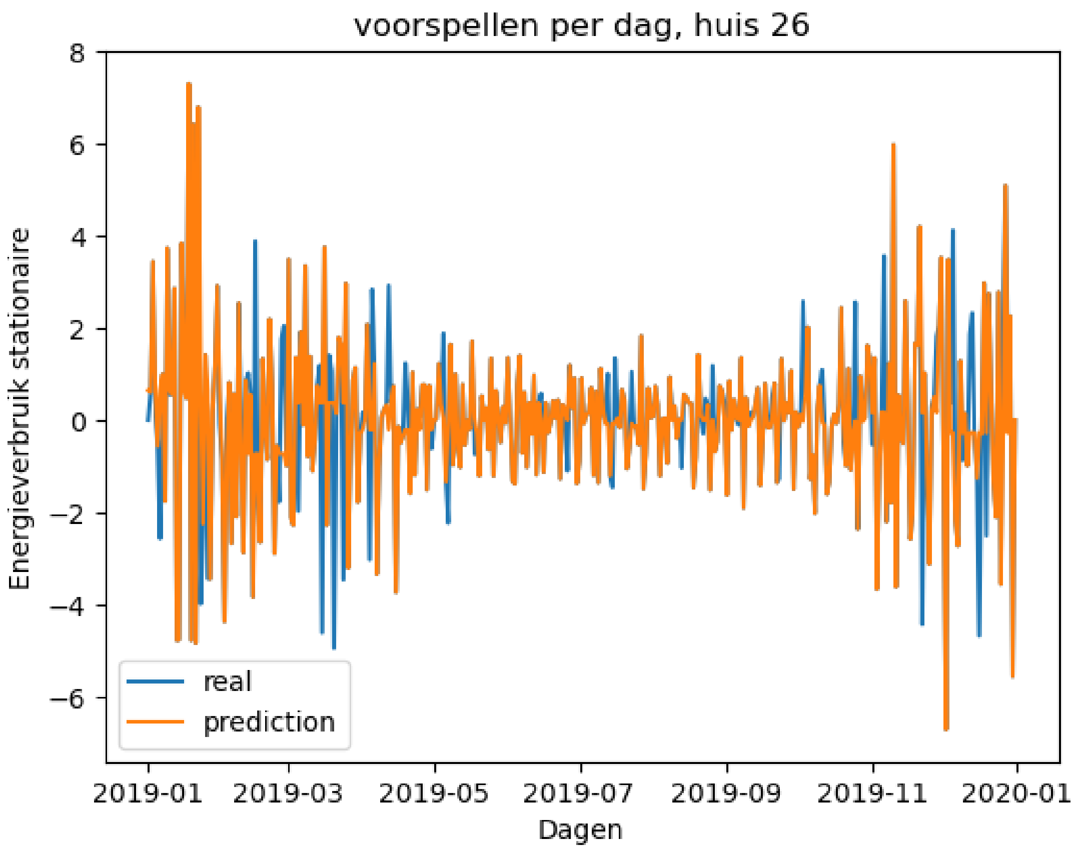
[288]:

```
X= huis026.drop('perdag_verbruik_st', axis=1).values
y= huis026['perdag_verbruik_st'].values
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
lr= LinearRegression()
lr.fit(X_train, y_train)
y_pred= lr.predict(X_test)
print('R2_score: %.3f' % (r2_score(y_test, y_pred)))
print('MAE: %.3f' % (mean_absolute_error(y_test, y_pred)))
print('MSE: %.3f' % (mean_squared_error(y_test, y_pred)))

plt.title('voorspellen per dag, huis 26')
plt.plot(huis026.index, y, label='real')
plt.plot(huis026.index, lr.predict(X), label='prediction')
plt.xlabel('Dagen')
plt.ylabel('Energieverbruik stationaire')
plt.legend()
```

```
R2_score: -0.140
MAE: 1.601
MSE: 4.581
```

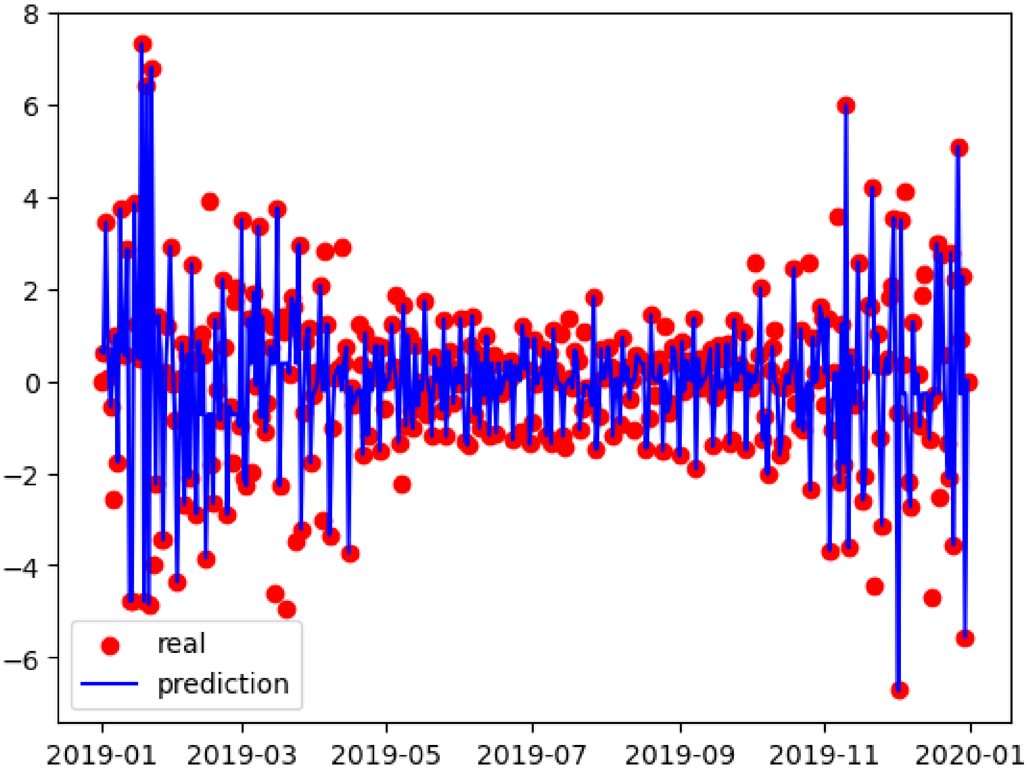
[288]:

```
<matplotlib.legend.Legend at 0x7f52d8a73e20>
```



```
[289]: plt.scatter(huis026.index, y, color='red', label='real')
       plt.plot(huis026.index, lr.predict(X), color='blue', label='prediction')
       plt.legend()
       print(r2_score(y_test, y_pred))
```

```
-0.13957119480102675
```



met normale data

[374]:

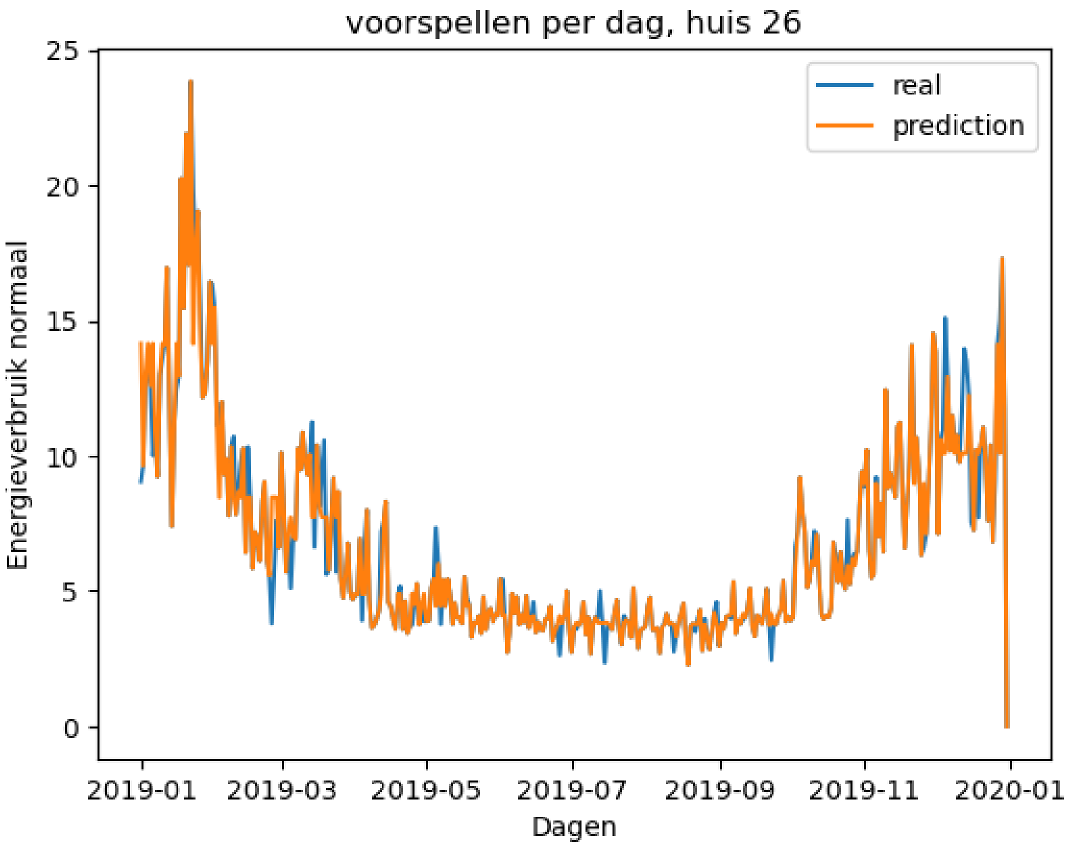
```
huis026new= pd.get_dummies(huis26.loc[:,['maand', 'dag']], columns = ['maand',␣
 ↪'dag'])
huis026new= pd.concat([huis026new, huis26.loc[:,['perdag_verbruik']]], axis=1)
```

[375]:

```
X= huis026new.drop('perdag_verbruik', axis=1).values
y= huis026new['perdag_verbruik'].values
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
lr= LinearRegression()
lr.fit(X_train, y_train)
y_pred= lr.predict(X_test)
print('R2_score: %.3f' % (r2_score(y_test, y_pred)))
print('MAE: %.3f' % (mean_absolute_error(y_test, y_pred)))
print('MSE: %.3f' % (mean_squared_error(y_test, y_pred)))

plt.title('voorspellen per dag, huis 26')
plt.plot(huis026new.index, y, label='real')
plt.plot(huis026new.index, lr.predict(X), label='prediction')
plt.xlabel('Dagen')
plt.ylabel('Energieverbruik normaal')
plt.legend()
```

```
R2_score: 0.713
MAE: 1.528
MSE: 4.289
```

```
[375]: <matplotlib.legend.Legend at 0x7f52c3ffbee0>
```



13 huis 116, met dummies

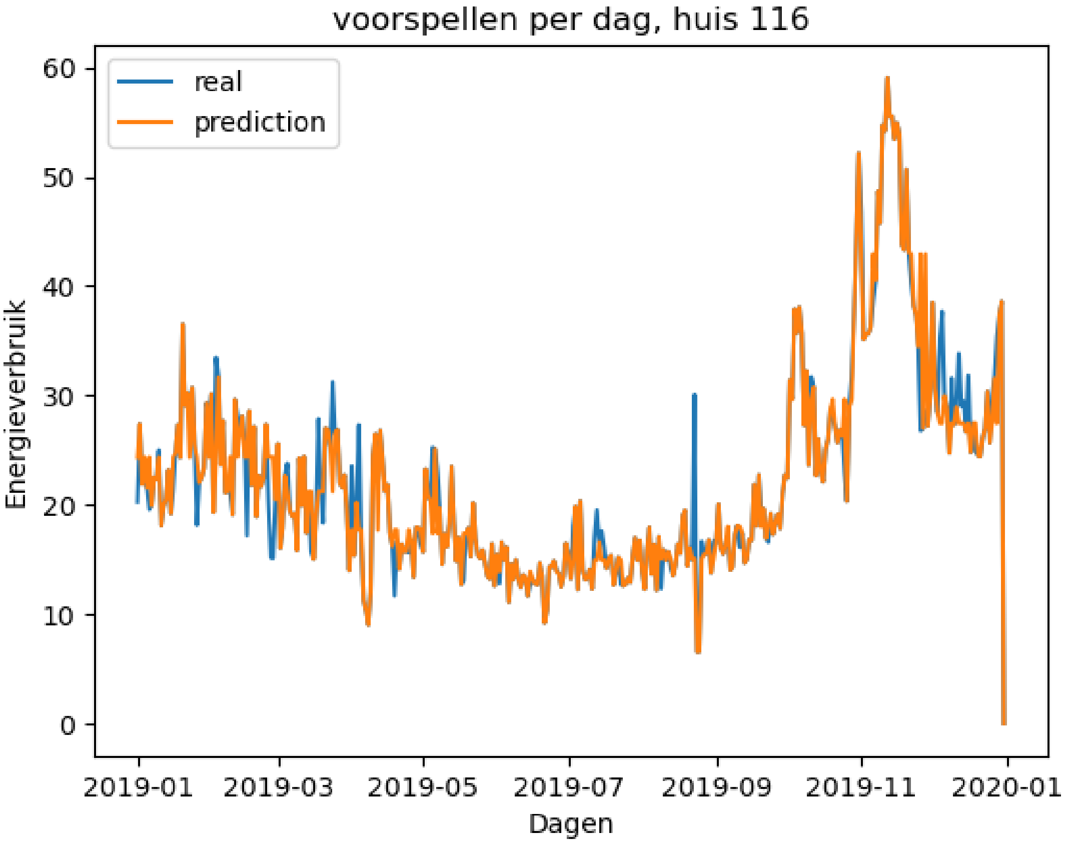
```
[376]: huis0116= pd.get_dummies(huis116.loc[:,['maand', 'dag']], columns = ['maand',␣
         ↪'dag'])
       huis0116= pd.concat([huis0116, huis116.loc[:,['perdag_verbruik']]], axis=1)
```

```
[377]: X= huis0116.drop('perdag_verbruik', axis=1).values
       y= huis0116['perdag_verbruik'].values
       X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
         ↪random_state=42)
```

```
lr= LinearRegression()
lr.fit(X_train, y_train)
y_pred= lr.predict(X_test)
print('R2 score: ', r2_score(y_test, y_pred))
plt.title('voorspellen per dag, huis 116')
plt.plot(huis0116.index, y, label='real')
plt.plot(huis0116.index, lr.predict(X), label='prediction')
plt.xlabel('Dagen')
plt.ylabel('Energieverbruik')
plt.legend()
```

```
R2 score:  0.5031000940677433
```

```
[377]: <matplotlib.legend.Legend at 0x7f52c4001d30>
```



14 dummies peruur

[378]:

```
df26uur= pd.read_csv('df026_per1uur', index_col=0).dropna()
df26uur['datum'] = pd.to_datetime(df26uur.index, errors='coerce')
df26uur['maand'] = df26uur['datum'].dt.strftime('%m')
df26uur.rename({'perdag_verbruik':'peruur_verbruik'}, axis=1, inplace=True,␣
  ↪errors='ignore')
df26uur= df26uur[['maand', 'peruur_verbruik', 'datum']]
df26uur
```

[378]:

```
                    maand  peruur_verbruik               datum
2019-01-01 00:00:00    01           0.4895 2019-01-01 00:00:00
2019-01-01 01:00:00    01           1.2425 2019-01-01 01:00:00
2019-01-01 02:00:00    01           0.1390 2019-01-01 02:00:00
2019-01-01 03:00:00    01           0.1375 2019-01-01 03:00:00
2019-01-01 04:00:00    01           0.1390 2019-01-01 04:00:00
…                    …               …                 …
2019-12-31 18:00:00    12           0.6720 2019-12-31 18:00:00
2019-12-31 19:00:00    12           0.2100 2019-12-31 19:00:00
2019-12-31 20:00:00    12           0.6065 2019-12-31 20:00:00
2019-12-31 21:00:00    12           0.6705 2019-12-31 21:00:00
2019-12-31 22:00:00    12           0.2400 2019-12-31 22:00:00

[8759 rows x 3 columns]
```

[379]:

```
df26uur['dag'] = 0
df26uur['uur'] = 0
for i in range(len(df26uur)):
    df26uur['dag'][i] = df26uur['datum'][i].timetuple().tm_yday
    df26uur['uur'][i] = df26uur['datum'][i].hour
```

```
/tmp/ipykernel_43694/2567359038.py:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df26uur['dag'][i] = df26uur['datum'][i].timetuple().tm_yday
/tmp/ipykernel_43694/2567359038.py:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df26uur['uur'][i] = df26uur['datum'][i].hour
```

[380]:

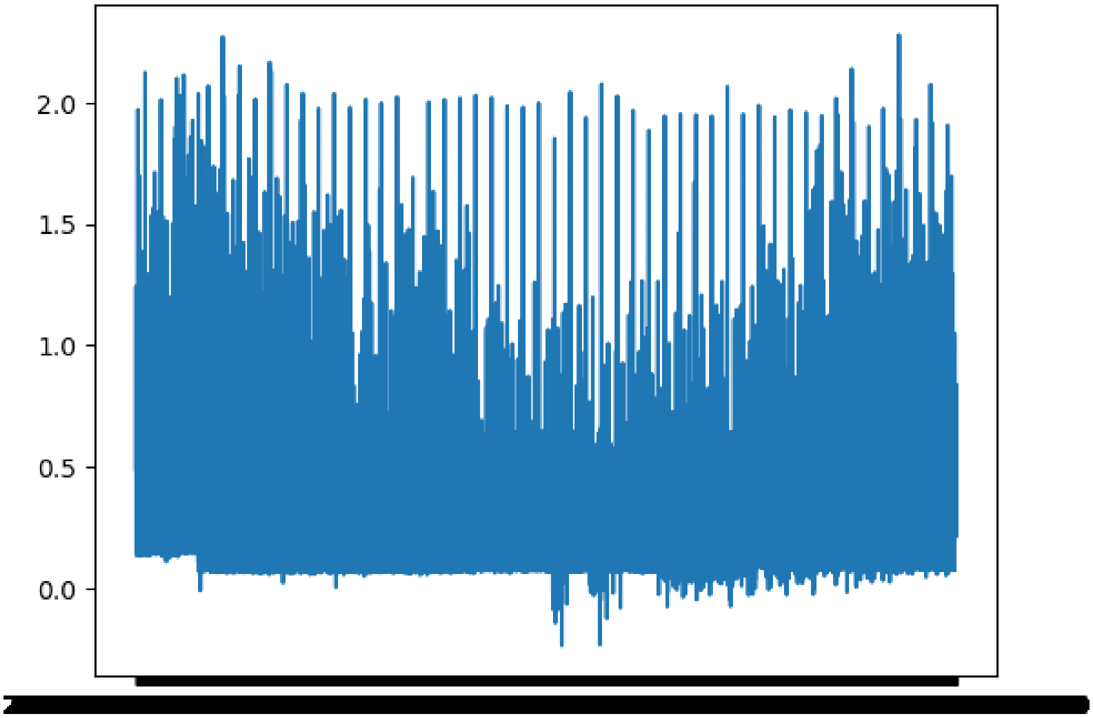
```
df26uur= df26uur[['maand', 'dag', 'uur', 'peruur_verbruik']]
```

[381]:

```
plt.plot(df26uur.index, df26uur.peruur_verbruik)
```

[381]:

```
[<matplotlib.lines.Line2D at 0x7f52c3cbdc10>]
```



[382]:

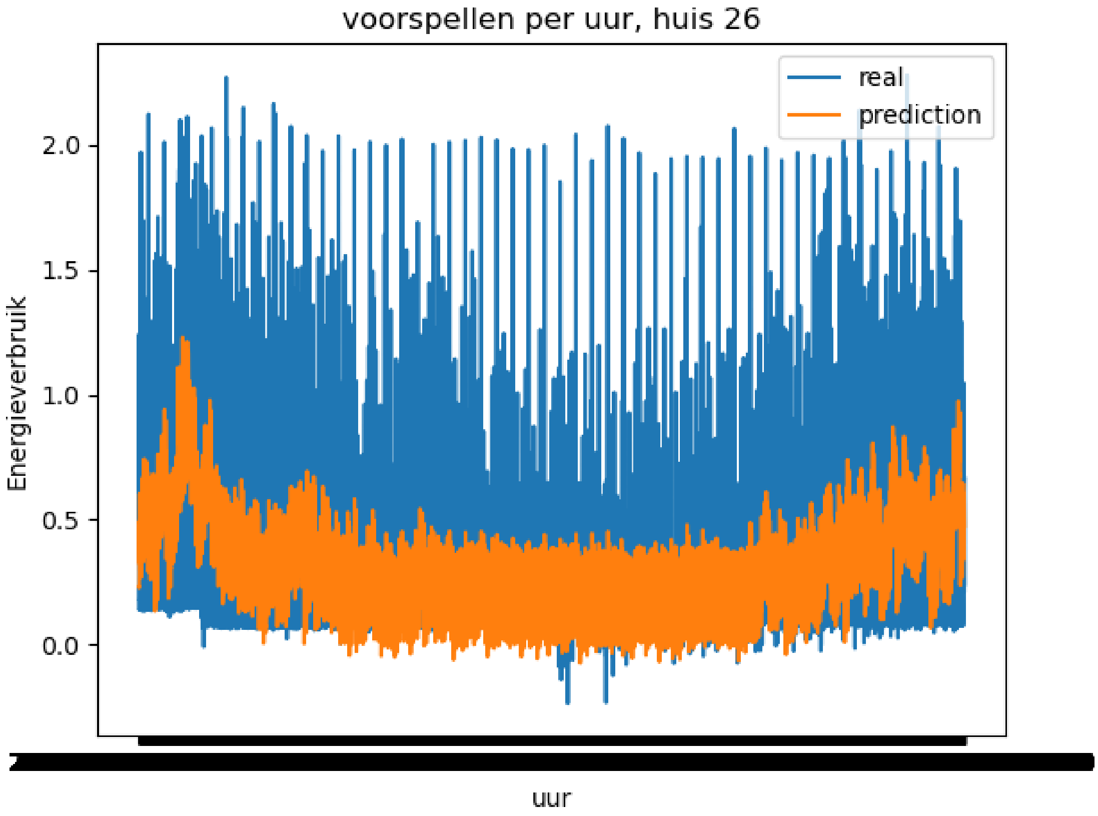
```
df26dum= pd.get_dummies(df26uur.loc[:,['maand', 'dag', 'uur']], columns =␣
 ↪['maand', 'dag', 'uur'])
df26dum= pd.concat([df26dum, df26uur.loc[:,['peruur_verbruik']]], axis=1)
```

[422]:

```
X= df26dum.drop('peruur_verbruik', axis=1).values
y= df26dum['peruur_verbruik'].values
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
lr= LinearRegression()
lr.fit(X_train, y_train)
y_pred= lr.predict(X_test)
print('R2 score: ', r2_score(y_test, y_pred))
plt.title('voorspellen per uur, huis 26')
plt.plot(df26dum.index, y, label='real')
plt.plot(df26dum.index, lr.predict(X), label='prediction')
plt.xlabel('uur')
plt.ylabel('Energieverbruik')
plt.legend()
```

```
R2 score:  0.2290703855147671
```

```
[422]: <matplotlib.legend.Legend at 0x7f5291b83f40>
```



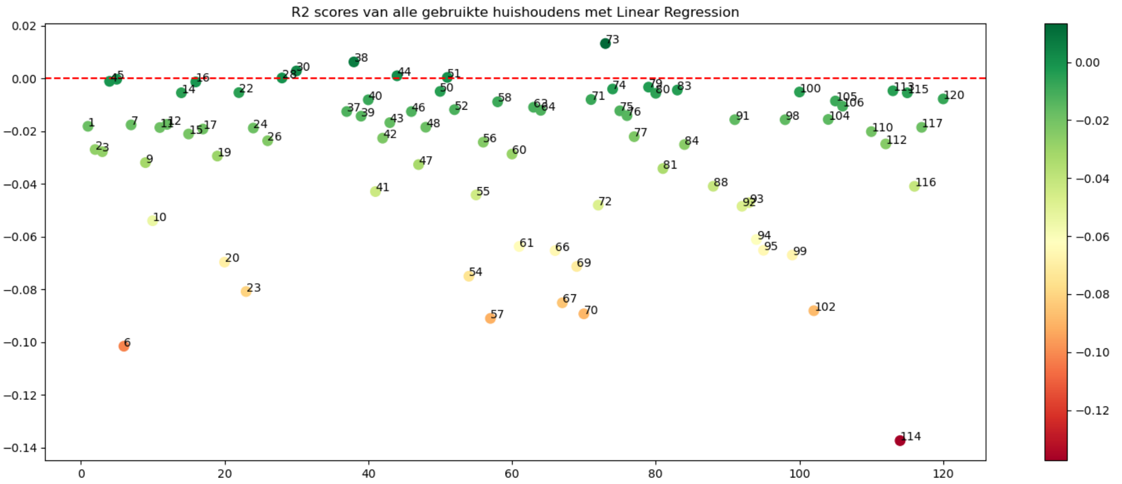
15 kijken naar de scores van alle huisjes

```
[449]: def scores(huisnr):

           r2_list = []
           mse_list = []
           mae_list = []

           for i in wel_gebruiken:
               huis = 'df0' + str(i) + '_perdag'
               df = pd.read_csv(huis, index_col=0)

               df.index = pd.to_datetime(df.index, errors='coerce')
               df['datum'] = df.index
               df['perdag_verbruik_st']= df['perdag_verbruik'].diff()
               df['maand'] = df['datum'].dt.strftime('%m')
               df['dag']= [*range(1, len(df)+1)]
```

```
        df= df[['dag', 'maand', 'perdag_verbruik', 'perdag_verbruik_st']].
 ↪fillna(0)
        df= df[:-1]

        X= df[['dag', 'maand']]
        y= df['perdag_verbruik_st']
        X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.
 ↪2, random_state=42)
        lr= LinearRegression()
        lr.fit(X_train, y_train)
        y_pred= lr.predict(X_test)


        r2 = r2_score(y_test, y_pred)
        MAE = mean_absolute_error(y_test, y_pred)
        MSE = mean_squared_error(y_test, y_pred)

        r2_list.append(r2)
        mae_list.append(MAE)
        mse_list.append(MSE)

        return(f'R2: {(r2_list)}', f'MAE: {(mae_list)}', f'MSE: {(mse_list)}')
```

[452]:

```
plt.rcParams["figure.autolayout"] = True
fig, ax = plt.subplots(1, figsize=(15,6))
points = ax.scatter(wel_gebruiken, r2_list, c=r2_list, s=70, cmap='RdYlGn')
fig.colorbar(points)
ax.axhline(y=0, color='r', linestyle='--')
ax.set_title('R2 scores van alle gebruikte huishoudens met Linear Regression')
for i, txt in enumerate(wel_gebruiken):
    ax.annotate(txt, (wel_gebruiken[i], r2_list[i]))
```



```
[419]: max(r2_list), min(r2_list)

[419]: (0.013269543465588396, -0.13739559161686432)

[420]: max(mae_list), min(mae_list)

[420]: (6.834356322475865, 1.454185992476752)

[421]: max(mse_list), min(mse_list)

[421]: (83.96527217776291, 3.565212425657668)

[450]: scores(26)

[450]: ('R2: [-0.018123437208521498]',
         'MAE: [3.606614107998133]',
         'MSE: [30.837968449648354]')

[451]: scores(73)

[451]: ('R2: [-0.018123437208521498]',
         'MAE: [3.606614107998133]',
         'MSE: [30.837968449648354]')

  [ ]:
```