In [11]:

```
%load_ext autoreload
%autoreload 2

import sys
sys.path.append("../")

import pandas as pd
import numpy as np
import statsmodels.api as sm
import statsmodels.graphics as sg


import matplotlib.pylab as plt

import seaborn as sns
sns.set_theme()

from sklearn.metrics import r2_score, mean_squared_error
from sklearn.linear_model import LinearRegression

import statsmodels.api as sm
import statsmodels.formula.api as smf
from statsmodels.stats.outliers_influence import OLSInfluence

from pygam import LinearGAM, s, l
from pygam.datasets import wage


import seaborn as sns
import matplotlib.pyplot as plt

from dmba import stepwise_selection
from dmba import AIC_score

%matplotlib inline
```

```
The autoreload extension is already loaded. To reload it, use:
  %reload_ext autoreload
```

In [12]:

```
df = pd.read_csv('../data/nts.csv', index_col=0, parse_dates=True)
df.shape, df.columns
```

Out[12]:

```
((42, 15),
 Index(['rynek', 'inflacja_r', 'inflacja_q', 'stopa_procentowa',
        'liczba_kredytow', 'tempo_wzrostu', 'ufnosc', 'duze_zakupy',
        'bezrobocie', 'spr_detaliczna', 'pkb', 'wynag', 'inflacja_q_ku
m',
        'ogolem', 'rpk'],
       dtype='object'))
```

In [20]:

```
predictors = ['inflacja_r', 'inflacja_q', 'stopa_procentowa',
        'liczba_kredytow', 'tempo_wzrostu', 'ufnosc', 'duze_zakupy',
        'bezrobocie', 'spr_detaliczna', 'pkb', 'wynag', 'inflacja_q_kum',
        'ogolem', 'rpk']
outcome = 'rynek'

model = LinearRegression()

bn = 37
```

```
model.fit(X=df[predictors].iloc[:bn], y=df[outcome].iloc[:bn])

print(f'Wyraz wolny: {model.intercept_:.3f}')
print('Współczynniki:')
for name, coef in zip(predictors, model.coef_):
    print(f' {name}: {coef}')
```

```
Wyraz wolny: 9241.832
Współczynniki:
 inflacja_r: -27.007597094080783
 inflacja_q: -38.893426250826906
 stopa_procentowa: 13377.093887206072
 liczba_kredytow: 0.01731614343817256
 tempo_wzrostu: -59.27660706477059
 ufnosc: -23.08856390632795
 duze_zakupy: -4.037395044947253
 bezrobocie: 6.33587746349118
 spr_detaliczna: 16.144534333623447
 pkb: 8.85640126139158
 wynag: 2.4084176822627157
 inflacja_q_kum: -4034.808805515178
 ogolem: -0.004609262250147239
 rpk: 0.0
```

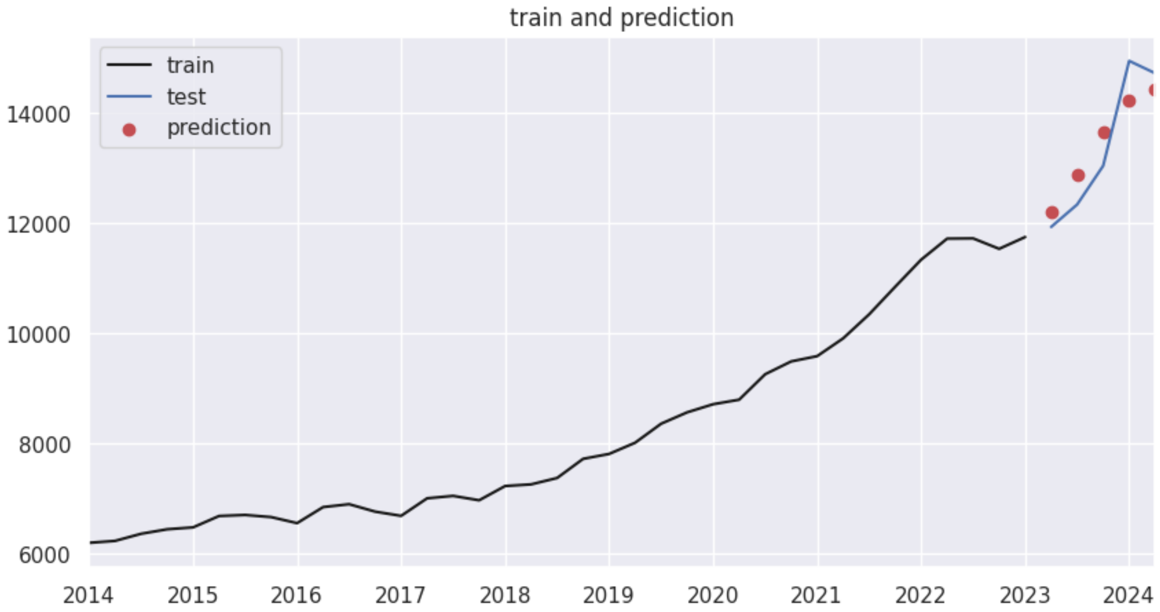
```
In [27]: preds = model.predict(df[predictors].iloc[bn:])
         RMSE = np.sqrt(mean_squared_error(df[outcome].iloc[bn:], preds))
         r2 = r2_score(df[outcome].iloc[bn:], preds)
         print(f'RMSE: {RMSE:.0f}')
         print(f'r2: {r2:.4f}')
```

```
RMSE: 517
r2: 0.8229
```

```
In [39]: preds, df.index[bn:]
```

```
Out[39]: (array([12188.64894668, 12865.73931734, 13658.13377819, 14227.55739409,
                 14415.16922223]),
          DatetimeIndex(['2023-06-30', '2023-09-30', '2023-12-31', '2024-03-31',
                         '2024-06-30'],
                        dtype='datetime64[ns]', freq=None))
```

```
In [46]: fig = plt.Figure()
         ax = fig.gca()
         df['rynek'].iloc[:bn].plot(style='k', figsize=(10,5), label = 'train', ax
         df['rynek'].iloc[bn:].plot(style='b', figsize=(10,5), label = 'test', ax=
         ax.scatter(x=df.index[bn:], y=preds, c='r',   label = 'prediction')
         ax.set_title('train and prediction')
         ax.legend()
         fig.savefig('../images/lr_output.png')
         display(fig)
```



In [41]:

```
model = sm.OLS(df[outcome], df[predictors].assign(const=1))
results = model.fit()
print(results.summary())
```

```
                            OLS Regression Results
==========================================================================
====
Dep. Variable:                  rynek   R-squared:
0.996
Model:                            OLS   Adj. R-squared:
0.994
Method:                 Least Squares   F-statistic:                     5
18.8
Date:                Mon, 16 Dec 2024   Prob (F-statistic):           4.78
e-29
Time:                        11:35:32   Log-Likelihood:                -26
9.30
No. Observations:                  42   AIC:                             5
68.6
Df Residuals:                      27   BIC:                             5
94.7
Df Model:                          14
Covariance Type:            nonrobust
==========================================================================
==========
                       coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------
----------
inflacja_r         -42.8063     38.334     -1.117      0.274    -121.462
35.849
inflacja_q         -72.2687     61.416     -1.177      0.250    -198.284
53.747
stopa_procentowa  1.617e+04   5449.041      2.967      0.006    4986.618
2.73e+04
liczba_kredytow      0.0204      0.007      3.008      0.006       0.006
0.034
tempo_wzrostu      -49.4437     46.555     -1.062      0.298    -144.967
46.080
ufnosc             -31.3060     29.542     -1.060      0.299     -91.922
29.310
duze_zakupy          1.9986     21.709      0.092      0.927     -42.544
46.541
bezrobocie           5.0389     82.263      0.061      0.952    -163.750
173.828
spr_detaliczna      42.1357     19.132      2.202      0.036       2.881
81.391
pkb                -26.0818     28.737     -0.908      0.372     -85.045
32.881
wynag                2.4606      0.514      4.788      0.000       1.406
3.515
inflacja_q_kum   -3835.8214   3529.897     -1.087      0.287   -1.11e+04
3406.929
ogolem              -0.0115      0.018     -0.651      0.521      -0.048
0.025
rpk               -884.7307    227.921     -3.882      0.001   -1352.385
-417.076
const             1.344e+04   6210.021      2.165      0.039     701.597
2.62e+04
==========================================================================
====
Omnibus:                        0.586   Durbin-Watson:
1.617
Prob(Omnibus):                  0.746   Jarque-Bera (JB):
```

```
0.701
Skew:                           0.232   Prob(JB):                         
0.704
Kurtosis:                       2.569   Cond. No.                     1.42
e+07
==========================================================================
====

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is cor
rectly specified.
[2] The condition number is large, 1.42e+07. This might indicate that ther
e are
strong multicollinearity or other numerical problems.
```

In [ ]: