VES_prognoze

September 22, 2024

[1]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
from datetime import datetime, date, time
import matplotlib.pyplot as plt
from pandas.plotting import scatter_matrix
from statsmodels.stats.outliers_influence import variance_inflation_factor
from sklearn.ensemble import RandomForestRegressor
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.model_selection import GridSearchCV
```

[2]:
```
# ielādē dotos datus
path = "C:/Users/ilzep/Documents/SadalesTikls/"
grob = "GrobinasVES.xlsx"
energ = pd.read_excel(path+grob)

energ['datums'] = pd.to_datetime(energ['datums'], format='%d.%m.%Y')
energ['laiks'] = pd.to_datetime(energ['laiks'], format='%H:%M:%S')
energ['laiks'] = energ['laiks'].dt.time
energ['datums'] = energ['datums'].dt.date

energ['DateTime'] = energ.apply(lambda row: datetime.combine(row['datums'],␣
↪row['laiks']), axis=1)
energ.drop(['datums', 'laiks'], axis=1, inplace=True)
```

[3]:
```
# ielādē un apvieno meteoroloģisko datu failus
files = [
    "veja_atrums.xlsx", #fakt
    "veja_atr_minim.xlsx",
    "brazmas_stunda.xlsx",
    "veja_virziens.xlsx", # fakt
    "temperatura.xlsx", #fakt
    "mitrums.xlsx", #fakt
    "spiediens.xlsx"  # fakt
]
meteo = None
```

```
for file in files:
    df = pd.read_excel(path+file)
    df = df.drop([0]).reset_index(drop=True)
    df.columns = df.iloc[0]
    df = df.drop(0).reset_index(drop=True)

    df_melted = df.melt(id_vars=['Datums'], var_name='laiks',␣
 ↪value_name='Value')
    df_melted['Value'] = pd.to_numeric(df_melted['Value'])
    column_name = file.split('.')[0]
    df_melted = df_melted[['Datums', 'laiks', 'Value']].rename(columns={'Value':
 ↪ column_name})
    df_melted['Datums'] = pd.to_datetime(df_melted['Datums'], format='%d.%m.%Y')
    df_melted['laiks'] = pd.to_datetime(df_melted['laiks'], format='%H:%M')
    df_melted['laiks'] = df_melted['laiks'].dt.time
    df_melted['DateTime'] = df_melted.apply(lambda row: datetime.
 ↪combine(row['Datums'], row['laiks']), axis=1)
    df_melted.drop(['Datums', 'laiks'], axis=1, inplace=True)
    if meteo is None:
        meteo = df_melted
    else:
        meteo = pd.merge(meteo, df_melted, on=['DateTime'], how='outer')
```

[4]:
```
# gaisa blīvuma aprēķins
e0 = 610.5
T1 = 17.269
T2 = 237.3
R = 287

meteo['E'] = e0 * np.exp((T1 * meteo['temperatura']) / (T2 +␣
 ↪meteo['temperatura']))
meteo['e'] = meteo['E'] * meteo['mitrums'] / 100
meteo['blivums'] = (meteo['spiediens']*100 / (R * (meteo['temperatura']+273)))␣
 ↪* (1 - (0.378 * meteo['e'] / (meteo['spiediens']*100)))
meteo = meteo.drop(columns=['E', 'e'])
```

[5]:
```
meteo['atrums^3'] = meteo['veja_atrums']**3
meteo['brazmas_stunda^3'] = meteo['brazmas_stunda']**3
meteo['vejs_vid'] = (meteo['veja_atr_minim'] + meteo['brazmas_stunda'])/2
meteo['vejs_vid^3'] = meteo['vejs_vid']**3
meteo['brazmainums'] = meteo['brazmas_stunda'] - meteo['veja_atr_minim']
```

[6]:
```
# sadalu meteo datus tajos, kam ir zināms ģenerētās enerģijas daudzums, un␣
 ↪tajos, kam jāprognozē
split_date = pd.to_datetime('01.06.2023', format='%d.%m.%Y')
meteo_maijs = meteo[meteo['DateTime'] < split_date]
```

```python
meteo_jun_jul = meteo[meteo['DateTime'] >= split_date]
```

[7]:
```python
dati = pd.merge(energ, meteo_maijs, on=['DateTime'], how='inner')
dati_cleaned = dati.dropna()
```

[8]:
```python
# aprēķinu korelāciju starp visiem lielumiem
kolonnas = ['kWh', 'veja_atrums', 'atrums^3', 'vejs_vid', 'vejs_vid^3',␣
 ↪'brazmas_stunda', 'brazmas_stunda^3', 'brazmainums', 'veja_atr_minim',
            'blivums', 'mitrums', 'temperatura']
mat = dati[kolonnas]
correlation_matrix = mat.corr()
correlation_matrix
```

[8]:
```
                        kWh  veja_atrums  atrums^3  vejs_vid  vejs_vid^3  \
kWh                1.000000     0.659993  0.744639  0.651503    0.726409
veja_atrums        0.659993     1.000000  0.894150  0.925511    0.841920
atrums^3           0.744639     0.894150  1.000000  0.821065    0.904733
vejs_vid           0.651503     0.925511  0.821065  1.000000    0.901390
vejs_vid^3         0.726409     0.841920  0.904733  0.901390    1.000000
brazmas_stunda     0.643419     0.919003  0.811247  0.996917    0.894401
brazmas_stunda^3   0.730472     0.837518  0.892318  0.902009    0.992004
brazmainums        0.629879     0.905231  0.794590  0.986369    0.880274
veja_atr_minim     0.442764     0.577437  0.554160  0.583023    0.569123
blivums            0.072187    -0.199605 -0.129487 -0.199980   -0.137890
mitrums            0.003715    -0.295422 -0.109106 -0.302335   -0.137246
temperatura       -0.160282     0.157436  0.053207  0.162812    0.066556

                  brazmas_stunda  brazmas_stunda^3  brazmainums  \
kWh                     0.643419          0.730472     0.629879
veja_atrums             0.919003          0.837518     0.905231
atrums^3                0.811247          0.892318     0.794590
vejs_vid                0.996917          0.902009     0.986369
vejs_vid^3              0.894401          0.992004     0.880274
brazmas_stunda          1.000000          0.902434     0.996239
brazmas_stunda^3        0.902434          1.000000     0.896436
brazmainums             0.996239          0.896436     1.000000
veja_atr_minim          0.517482          0.492699     0.441388
blivums                -0.221352         -0.153117    -0.243370
mitrums                -0.307955         -0.141038    -0.311956
temperatura             0.185395          0.086488     0.209009

                  veja_atr_minim   blivums   mitrums  temperatura
kWh                     0.442764  0.072187  0.003715    -0.160282
veja_atrums             0.577437 -0.199605 -0.295422     0.157436
atrums^3                0.554160 -0.129487 -0.109106     0.053207
vejs_vid                0.583023 -0.199980 -0.302335     0.162812
vejs_vid^3              0.569123 -0.137890 -0.137246     0.066556
```

```
brazmas_stunda          0.517482 -0.221352 -0.307955     0.185395
brazmas_stunda^3        0.492699 -0.153117 -0.141038     0.086488
brazmainums             0.441388 -0.243370 -0.311956     0.209009
veja_atr_minim          1.000000  0.111100 -0.108419    -0.144132
blivums                 0.111100  1.000000  0.501110    -0.964320
mitrums                -0.108419  0.501110  1.000000    -0.643505
temperatura            -0.144132 -0.964320 -0.643505     1.000000
```

[9]:
```python
# Linear Regression
kol_LR = ['atrums^3', 'blivums', 'brazmainums', 'temperatura']
X = dati_cleaned[kol_LR]
y = dati_cleaned['kWh']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
↪random_state=42)
model_LR = LinearRegression()
model_LR.fit(X_train, y_train)

y_LR = model_LR.predict(X_test)
rmse_LR = np.sqrt(mean_squared_error(y_test, y_LR))
r2_LR = r2_score(y_test, y_LR)
```

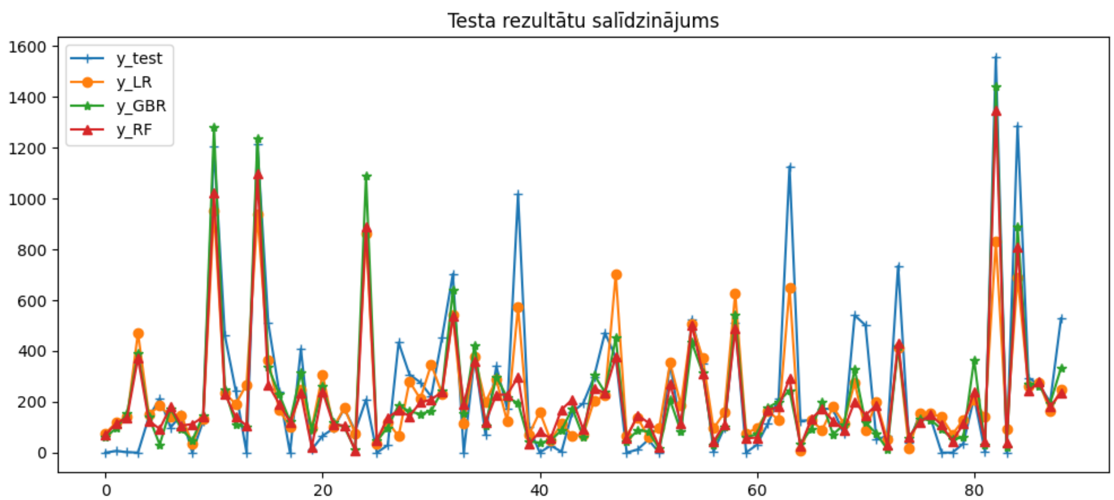
[10]:
```python
kolonnas = ['veja_atrums', 'atrums^3', 'vejs_vid', 'vejs_vid^3',␣
↪'brazmas_stunda', 'brazmas_stunda^3', 'brazmainums', 'veja_atr_minim',
            'blivums', 'mitrums', 'temperatura']
X = dati_cleaned[kolonnas]
y = dati_cleaned['kWh']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
↪random_state=42)
```

[11]:
```python
# Gradient Boosting
gbr = GradientBoostingRegressor(random_state=42)
param_grid = {
    'n_estimators': [100, 200],
    'learning_rate': [0.01, 0.1, 0.2],
    'max_depth': [2, 3, 4, 5],
    'min_samples_split': [2, 5, 10, 12],
    'min_samples_leaf': [1, 2, 4, 5],
    'subsample': [0.7, 0.8, 1.0]
}
grid_search = GridSearchCV(estimator=gbr, param_grid=param_grid, cv=5,␣
↪scoring='neg_mean_squared_error', n_jobs=-1, verbose=0)
grid_search.fit(X_train, y_train)

best_gbr = grid_search.best_estimator_
y_GBR = best_gbr.predict(X_test)
rmse_GBR = np.sqrt(mean_squared_error(y_test, y_GBR))
r2_GBR = r2_score(y_test, y_GBR)
```

[12]:
```
# Random Forest
rf = RandomForestRegressor(max_features='sqrt', random_state=42)
param_grid = {
    'n_estimators': [80, 100, 200, 300],
    'max_depth': [5, 7, 10, 20],
    'min_samples_split': [2, 5, 10],
    'min_samples_leaf': [1, 2, 4]
}
grid_search = GridSearchCV(estimator=rf, param_grid=param_grid, cv=5, scoring='neg_mean_squared_error', n_jobs=-1, verbose=0) #neg_mean_squared_error

grid_search.fit(X_train, y_train)

best_rf = grid_search.best_estimator_
y_RF = best_rf.predict(X_test)
rmse_RF = np.sqrt(mean_squared_error(y_test, y_RF))
r2_RF = r2_score(y_test, y_RF)
```

[13]:
```
# visu 3 metožu apvienojums
sal = pd.DataFrame(y_test)
sal['LR'] = y_LR
sal['GBR'] = y_GBR
sal['RF'] = y_RF
sal['total'] = (sal['LR']+sal['GBR']+sal['RF'])/3
rmse_tot = np.sqrt(mean_squared_error(y_test, sal['total']))
r2_tot = r2_score(y_test, sal['total'])
```

[14]:
```
# 3 metožu testa rezultātu salīdzinājums
x = np.arange(89)
plt.figure(figsize=(12, 5))
plt.plot(x, y_test, label='y_test', marker='+')
plt.plot(x, y_LR, label='y_LR', marker='o')
plt.plot(x, y_GBR, label='y_GBR', marker='*')
plt.plot(x, y_RF, label='y_RF', marker='^')

plt.legend()
plt.title('Testa rezultātu salīdzinājums')
plt.show()
```



[15]:
```
# 3 metožu skaitlisks novērtējums
modeli = {
    'Model': ['Linear Regression', 'Gradient Boosting', 'Random Forest',␣
 ↪'Total'],
    'RMSE': [rmse_LR, rmse_GBR, rmse_RF, rmse_tot],
    'R²': [r2_LR, r2_GBR, r2_RF, r2_tot]
}
vertejums = pd.DataFrame(modeli)
vertejums
```

[15]:

	Model	RMSE	R²
0	Linear Regression	199.111650	0.614909
1	Gradient Boosting	199.618315	0.612946
2	Random Forest	193.004482	0.638170
3	Total	188.646323	0.654326

[16]:
```
# dati prognozēšanai
meteo_jun_jul = meteo_jun_jul.dropna()
new_data = meteo_jun_jul[kolonnas]
dati_LR = meteo_jun_jul[kol_LR]
```

[17]:
```
# prognozēšana
predictions_GBR = best_gbr.predict(new_data)
predictions_RF = best_rf.predict(new_data)
predictions_LR = model_LR.predict(dati_LR)
```

[18]:
```
results = meteo_jun_jul[['DateTime']].copy()
results['LR'] = predictions_LR
results['GBR'] = predictions_GBR
results['RF'] = predictions_RF
```

```
results['kWh'] = (results['LR']+results['GBR']+results['RF'])/3
results = results.drop(columns=['LR', 'GBR', 'RF'])
```

[19]:
```
results.to_excel(path+'VES_prognoze.xlsx', index=False)
```