02.02-machine_learning_models

April 11, 2021

1 Modelos de Aprendizado de Máquina

Neste notebook tem os seguintes modelos de aprendizado de máquina comparados: - Floresta Aleatória - SVM

1.1 Importações

[2]:
```
# Data analysis and data wrangling
import numpy as np
import pandas as pd

# Metrics
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_percentage_error

# Plotting
import seaborn as sns
import matplotlib.pyplot as plt

# machine learning
from sklearn.ensemble import RandomForestRegressor
from sklearn.svm import SVR
import xgboost as xgb

# Other
from IPython.display import Image
import warnings
import pprint
import datetime
import os
```

1.2 Preparação do Diretório Principal

[3]:
```
def prepare_directory_work(end_directory: str='notebooks'):
    # Current path
    curr_dir = os.path.dirname (os.path.realpath ("__file__"))
```

```
    if curr_dir.endswith(end_directory):
        os.chdir('..')
        return curr_dir

    return f'Current working directory: {curr_dir}'
```

[4]:
```
prepare_directory_work(end_directory='notebooks')
```

[4]: '/home/campos/projects/tcc-ufsc-grad/notebooks'

1.3 Formatação das células

[5]:
```
# OPTIONAL: Load the "autoreload" extension so that code can change
%load_ext autoreload

# Guarantees visualization inside the jupyter
%matplotlib inline

# Print xxxx rows and columns
pd.set_option('display.max_rows', None)
pd.set_option('display.max_columns', None)
pd.set_option('float_format', '{:f}'.format)

# Supress unnecessary warnings so that presentation looks clean
warnings.filterwarnings('ignore')

# pretty print
pp = pprint.PrettyPrinter(indent=4)
```

[6]:
```
plt.style.use('seaborn')  # fivethirtyeight
plt.rc('figure',figsize=(16,8))
plt.rc('font',size=15)
plt.rc('legend',fontsize=15)

# Seaborn rcParams
# ===================
sns.set(context='poster',  # notebook
        style='darkgrid',
        palette='deep',
        color_codes=True)

# graph style
sns.set(style='dark', palette='deep')

plt.style.use('fivethirtyeight')
```

1.4 Carregamento dos Dados

[7]:
```
%%time

df_vale3 = pd.read_csv('data/cleansing/df_vale3_cleansing.csv',
                        encoding='utf8',
                        delimiter=',',
                        parse_dates=True,
                        index_col=0,
                        verbose=True)
```

```
Tokenization took: 3.43 ms
Type conversion took: 3.10 ms
Parser memory cleanup took: 0.01 ms
CPU times: user 11.9 ms, sys: 936 µs, total: 12.8 ms
Wall time: 13.9 ms
```

[8]:
```
print(df_vale3.info())
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 2445 entries, 2010-07-12 to 2020-05-28
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   preco         2445 non-null   float64
 1   residuos      2445 non-null   float64
 2   tendencia     2445 non-null   float64
 3   sazonalidade  2445 non-null   float64
 4   diff_1        2445 non-null   float64
 5   diff_2        2445 non-null   float64
 6   diff_3        2445 non-null   float64
 7   diff_4        2445 non-null   float64
 8   diff_5        2445 non-null   float64
dtypes: float64(9)
memory usage: 191.0 KB
None
```

[9]:
```
df_vale3.head()
```

[9]:
```
                preco  residuos  tendencia  sazonalidade    diff_1    diff_2  \
data
2010-07-12  40.000000  1.002310  41.827333      1.000149 -0.600000 -0.460000
2010-07-13  40.070000  1.036654  41.910833      0.998563  0.070000 -0.530000
2010-07-14  40.080000  1.028377  41.977833      1.000439  0.010000  0.080000
2010-07-15  39.760000  1.044658  42.045833      1.000935 -0.320000 -0.310000
2010-07-16  38.880000  1.028132  42.123500      1.001784 -0.880000 -1.200000

               diff_3    diff_4    diff_5
```

```
data
2010-07-12  0.490000  0.980000  0.420000
2010-07-13 -0.390000  0.560000  1.050000
2010-07-14 -0.520000 -0.380000  0.570000
2010-07-15 -0.240000 -0.840000 -0.700000
2010-07-16 -1.190000 -1.120000 -1.720000
```

1.5 Divisão dos Dados

[10]:
```
size_train = 2132
size_test = 313
print(size_train)
print(size_test)

df_train = df_vale3.iloc[:size_train]
df_test = df_vale3.iloc[size_train:]
print(df_train.columns)
print(df_test.columns)
```

```
2132
313
Index(['preco', 'residuos', 'tendencia', 'sazonalidade', 'diff_1', 'diff_2',
       'diff_3', 'diff_4', 'diff_5'],
      dtype='object')
Index(['preco', 'residuos', 'tendencia', 'sazonalidade', 'diff_1', 'diff_2',
       'diff_3', 'diff_4', 'diff_5'],
      dtype='object')
```

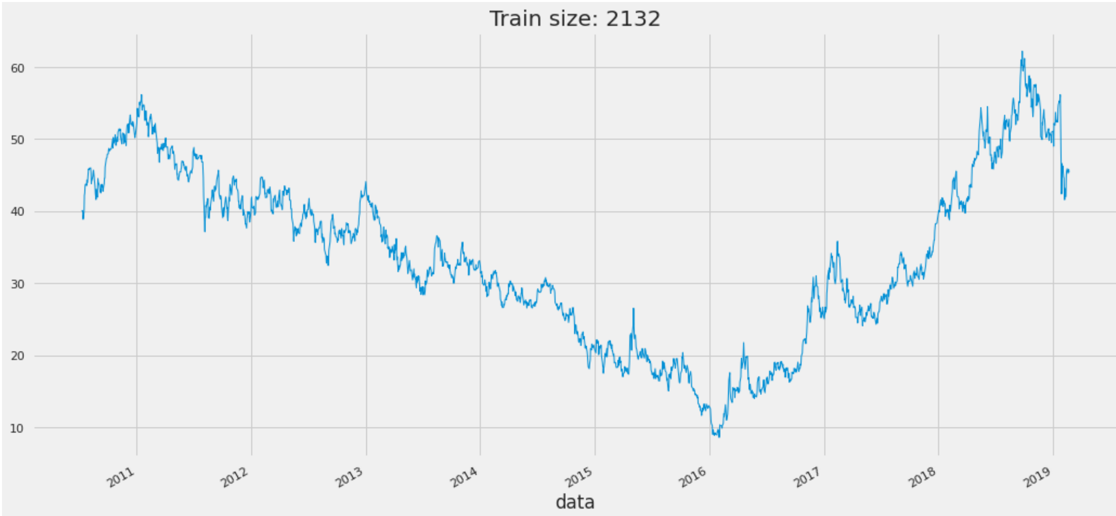
[11]:
```
df_vale3_without_target = df_train.columns
df_vale3_without_target = df_vale3_without_target.drop('preco')

print(df_vale3_without_target)
```

```
Index(['residuos', 'tendencia', 'sazonalidade', 'diff_1', 'diff_2', 'diff_3',
       'diff_4', 'diff_5'],
      dtype='object')
```

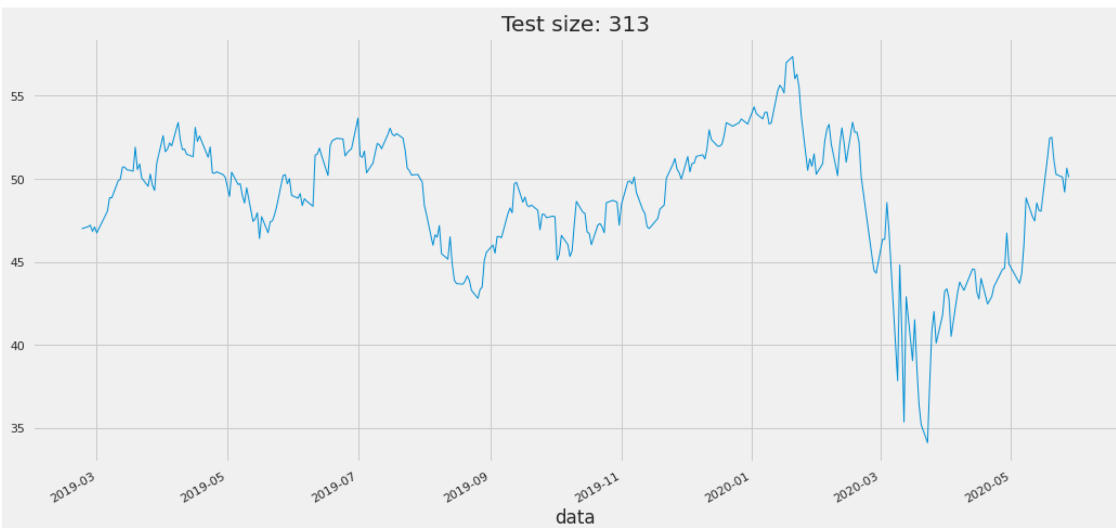
[12]:
```
df_train['preco'].plot(linewidth=1)
plt.grid(True)
plt.title(f'Train size: {len(df_train)}')
```

[12]: `Text(0.5, 1.0, 'Train size: 2132')`



[13]:
```
df_test['preco'].plot(linewidth=1)
plt.grid(True)
plt.title(f'Test size: {len(df_test)}')
```

[13]: Text(0.5, 1.0, 'Test size: 313')



[14]:
```
df_train.index
```

[14]:
```
DatetimeIndex(['2010-07-12', '2010-07-13', '2010-07-14', '2010-07-15',
               '2010-07-16', '2010-07-19', '2010-07-20', '2010-07-21',
               '2010-07-22', '2010-07-23',
               …
```

```
               '2019-02-08', '2019-02-11', '2019-02-12', '2019-02-13',
               '2019-02-14', '2019-02-15', '2019-02-18', '2019-02-19',
               '2019-02-20', '2019-02-21'],
              dtype='datetime64[ns]', name='data', length=2132, freq=None)
```

[15]:
```python
df_test.index
```

[15]:
```
DatetimeIndex(['2019-02-22', '2019-02-25', '2019-02-26', '2019-02-27',
               '2019-02-28', '2019-03-01', '2019-03-06', '2019-03-07',
               '2019-03-08', '2019-03-11',
               …
               '2020-05-15', '2020-05-18', '2020-05-19', '2020-05-20',
               '2020-05-21', '2020-05-22', '2020-05-25', '2020-05-26',
               '2020-05-27', '2020-05-28'],
              dtype='datetime64[ns]', name='data', length=313, freq=None)
```

[16]:
```python
X_train = df_train[df_vale3_without_target]
y_train = df_train['preco']
print(len(X_train))
print(len(y_train))
print(type(X_train))
print(type(y_train))
print((X_train[:5]))
print(y_train[:5])


X_train = df_train[df_vale3_without_target]
y_train = df_train['preco']
```

```
2132
2132
<class 'pandas.core.frame.DataFrame'>
<class 'pandas.core.series.Series'>
            residuos  tendencia  sazonalidade    diff_1    diff_2    diff_3  \
data
2010-07-12  1.002310  41.827333      1.000149 -0.600000 -0.460000  0.490000
2010-07-13  1.036654  41.910833      0.998563  0.070000 -0.530000 -0.390000
2010-07-14  1.028377  41.977833      1.000439  0.010000  0.080000 -0.520000
2010-07-15  1.044658  42.045833      1.000935 -0.320000 -0.310000 -0.240000
2010-07-16  1.028132  42.123500      1.001784 -0.880000 -1.200000 -1.190000

              diff_4    diff_5
data
2010-07-12  0.980000  0.420000
2010-07-13  0.560000  1.050000
2010-07-14 -0.380000  0.570000
2010-07-15 -0.840000 -0.700000
```

```
2010-07-16 -1.120000 -1.720000
data
2010-07-12   40.000000
2010-07-13   40.070000
2010-07-14   40.080000
2010-07-15   39.760000
2010-07-16   38.880000
Name: preco, dtype: float64
```

[17]:
```python
X_test = df_test[df_vale3_without_target]
y_test = df_test['preco']
print(len(X_test))
print(len(y_test))
print(type(X_test))
print(type(y_test))
print(X_test[:5])
print(y_test[:5])
```

```
313
313
<class 'pandas.core.frame.DataFrame'>
<class 'pandas.core.series.Series'>
            residuos  tendencia  sazonalidade    diff_1    diff_2    diff_3  \
data
2019-02-22  0.963506  46.696167      1.000439  1.610000  1.190000  1.500000
2019-02-25  0.933996  46.888333      1.000935  0.130000  1.740000  1.320000
2019-02-26  0.938870  47.090500      1.001784  0.080000  0.210000  1.820000
2019-02-27  0.891661  47.321167      1.000287 -0.370000 -0.290000 -0.160000
2019-02-28  0.880628  47.580333      1.001320  0.270000 -0.100000 -0.020000

             diff_4   diff_5
data
2019-02-22 1.740000 1.110000
2019-02-25 1.630000 1.870000
2019-02-26 1.400000 1.710000
2019-02-27 1.450000 1.030000
2019-02-28 0.110000 1.720000
data
2019-02-22   46.990000
2019-02-25   47.120000
2019-02-26   47.200000
2019-02-27   46.830000
2019-02-28   47.100000
Name: preco, dtype: float64
```

1.6 Dicionário de Resultados

[18]:
```
dict_results = {}
```

1.7 Impressão dos Resutados

[19]:
```
def show_result_model(df_train, df_test, y_forecast, model_name):
    future_forecast = pd.DataFrame(y_forecast,
                                   index=df_test.index,
                                   columns=['previsao'])
    mape = mean_absolute_percentage_error(df_test, y_forecast)*100
    mse = mean_squared_error(df_test, y_forecast, squared=True)
    dict_results[model_name] = [mape, mse]

    pd.concat([df_test, future_forecast], axis=1).plot()

    plt.legend()
    plt.grid(True)
    plt.xlabel("Tempo (dias)", fontsize=20)
    plt.ylabel("Preço (R$)", fontsize=20)
    plt.title(f'MAPE = {mape:.2f} % | MSE = {mse:.2f}', fontsize=25)
```

1.8 Floresta Aleatória

[20]:
```
# RandomForest params dict
rf_params_one = {}
rf_params_one['criterion'] = 'mse'
rf_params_one['n_estimators'] = 10
rf_params_one['max_depth'] = 5
rf_params_one['max_features'] = None
rf_params_one['max_leaf_nodes'] = 15
rf_params_one['min_samples_leaf'] = 1
rf_params_one['random_state'] = 0
rf_params_one['n_jobs'] = -1 # run all process
```

[21]:
```
model_rf_regressor = RandomForestRegressor(**rf_params_one)
model_rf_regressor
```

[21]:
```
RandomForestRegressor(max_depth=5, max_features=None, max_leaf_nodes=15,
                      n_estimators=10, n_jobs=-1, random_state=0)
```

[22]:
```
model_rf_regressor.fit(X_train, y_train)
```

[22]: RandomForestRegressor(max_depth=5, max_features=None, max_leaf_nodes=15,
                      n_estimators=10, n_jobs=-1, random_state=0)

[23]:
```
y_pred_rf_regressor = model_rf_regressor.predict(X_test)
y_pred_rf_regressor[:5]
```

[23]: array([46.87773307, 46.87773307, 46.87773307, 46.87773307, 46.87773307])

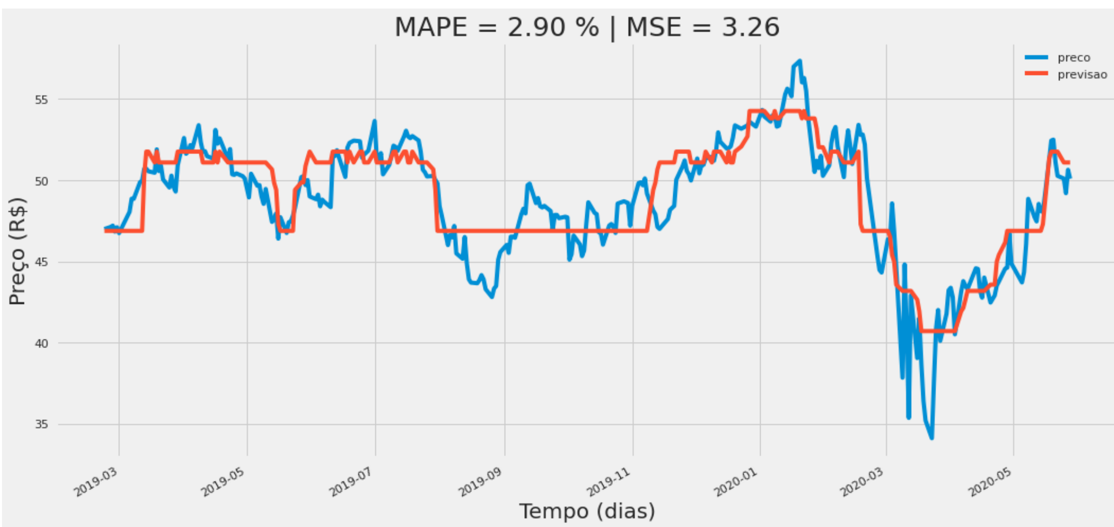
[24]:
```
len(y_train)
```

[24]: 2132

[25]:
```
len(y_test)
```

[25]: 313

[26]:
```
show_result_model(df_train=y_train,
                  df_test=y_test,
                  y_forecast=y_pred_rf_regressor,
                  model_name='model_rf_regressor')
```



1.8.1 SVM

- Doc sobre gamma: https://scikit-learn.org/stable/auto_examples/svm/plot_rbf_parameters.html
- Gamma é quem controla o learning rate

[27]:
```
model_svm_regressor = SVR(kernel='rbf', gamma= 0.1)
model_svm_regressor
```

[27]: SVR(gamma=0.1)

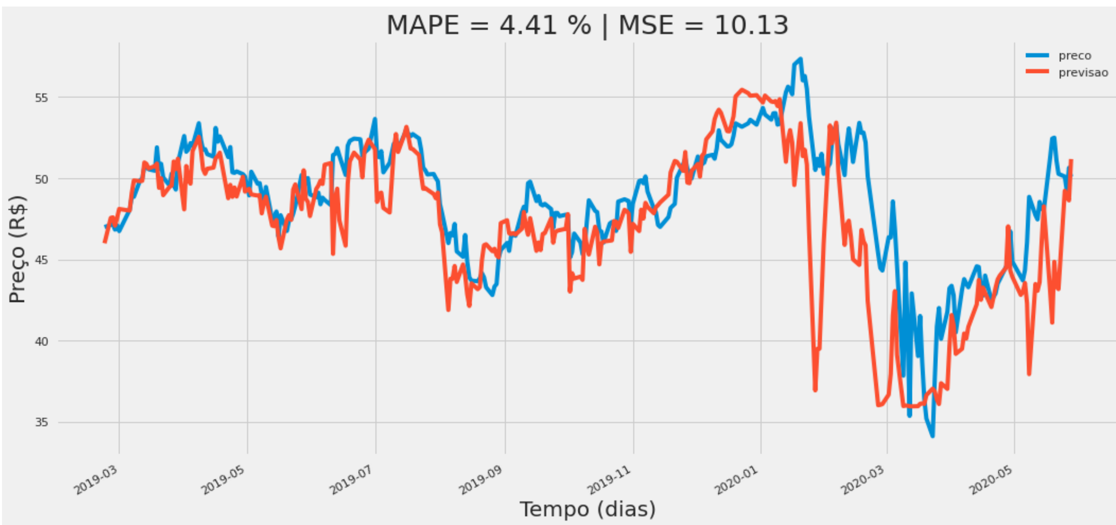
[28]:
```
model_svm_regressor.fit(X_train, y_train)
```

[28]: SVR(gamma=0.1)

[29]:
```
y_pred_svm_regressor = model_svm_regressor.predict(X_test)
y_pred_svm_regressor[:5]
```

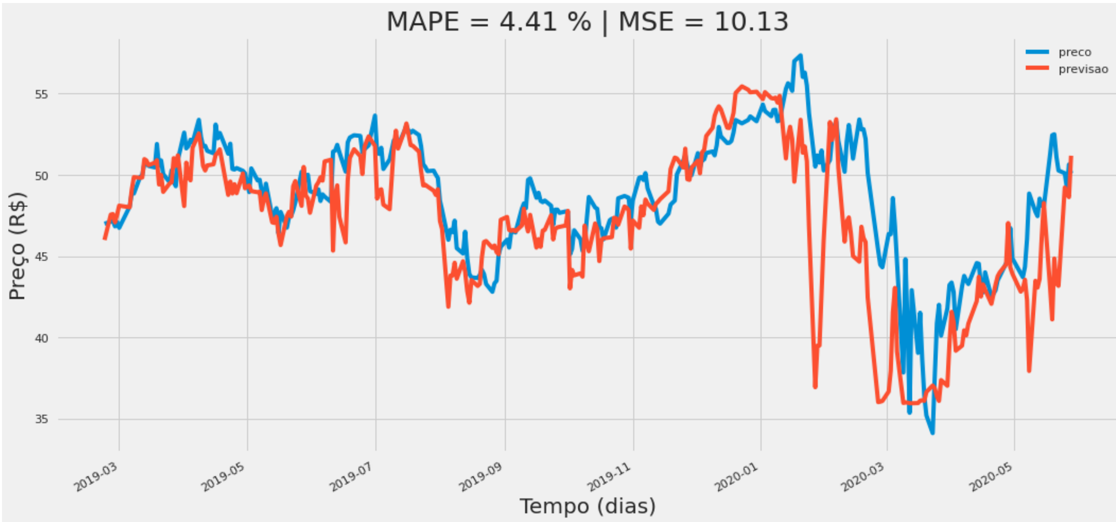
[29]: array([45.99084802, 47.55431383, 47.58521492, 47.0727281 , 47.54548022])

[30]:
```
show_result_model(df_train=y_train,
                  df_test=y_test,
                  y_forecast=y_pred_svm_regressor,
                  model_name='model_svm_regressor')
```



Zoom

[31]:
```
show_result_model(df_train=y_test,
                  df_test=y_test,
                  y_forecast=y_pred_svm_regressor,
                  model_name='model_svm_regressor')
```



1.9 Results

[32]:
```
dict_results
```

[32]:
```
{'model_rf_regressor': [2.9030604441613783, 3.2572285019921856],
 'model_svm_regressor': [4.408421946404582, 10.128906074086462]}
```
