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In [ ]: ###necessary libraries###
import numpy as np
import pandas as pd
from seglearn.transform import FeatureRep, SegmentXYForecast, last
from subprocess import check_output
from keras.layers import Dense, Activation, Dropout, Input, LSTM, Flatten
from keras.models import Model
from sklearn.metrics import r2_score
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
import matplotlib.pyplot as plt
from numpy import newaxis
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error
from math import sqrt
import glob
import os
from datetime import datetime
import math
from numpy.random import seed
import tensorflow as tf
import warnings
from sklearn.exceptions import DataConversionWarning
import xgboost as xgb
from sklearn.model_selection import ParameterSampler, ParameterGrid

model_seed = 100
# ensure same output results
seed(101)
tf.random.set_seed(model_seed)

# file where csv files lies
path = r'C:\Users\victo\Master_Thesis\merging_data\bmw\hourly\merged_files'
all_files = glob.glob(os.path.join(path, "*.csv"))

# read files to pandas frame
list_of_files = []

for filename in all_files:
    list_of_files.append(pd.read_csv(filename,
                                     sep=',',
                                     )
                        )

# Concatenate all content of files into one DataFrames
concatenate_dataframe = pd.concat(list_of_files,
                                   ignore_index=True,
                                   axis=0,
                                   )

# print(concatenate_dataframe)

new_df_flair_content = concatenate_dataframe[['OPEN',
                                             'HIGH',
                                             'LOW',
                                             'CLOSE',
                                             'VOLUME',
                                             'flair_sentiment_content_score']]

new_df_flair_content = new_df_flair_content.fillna(0)
# new_df[['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'compound_vader_articel_content
']].astype(np.float64)
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# print(new_df)

# train, valid, test split
valid_test_size_split_flair_content = 0.1

X_train_flair_content, \
X_else_flair_content, \
y_train_flair_content, \
y_else_flair_content = train_test_split(new_df_flair_content,
                                       new_df_flair_content['OPEN'],
                                       test_size=valid_test_size_split_flair_content*2,
                                       shuffle=False
                                       )

X_valid_flair_content, \
X_test_flair_content, \
y_valid_flair_content, \
y_test_flair_content = train_test_split(X_else_flair_content,
                                       y_else_flair_content,
                                       test_size=0.5,
                                       shuffle=False
                                       )

#print(y_else_flair_content)
warnings.filterwarnings(action='ignore', category=DataConversionWarning)

# normalize data
def minmax_scale_flair_content(df_x, series_y, normalizers_flair_content = None):
    features_to_minmax = ['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'flair_sentiment_score']

    if not normalizers_flair_content:
        normalizers_flair_content = {}

    for feat in features_to_minmax:
        if feat not in normalizers_flair_content:
            normalizers_flair_content[feat] = MinMaxScaler()
            normalizers_flair_content[feat].fit(df_x[feat].values.reshape(-1, 1))

        df_x[feat] = normalizers_flair_content[feat].transform(df_x[feat].values.reshape(-1, 1))

    series_y = normalizers_flair_content['OPEN'].transform(series_y.values.reshape(-1, 1))

    return df_x, series_y, normalizers_flair_content

X_train_norm_flair_content, \
y_train_norm_flair_content, \
normalizers_flair_content = minmax_scale_flair_content(X_train_flair_content,
                                                       y_train_flair_content
                                                       )

X_valid_norm_flair_content, \
y_valid_norm_flair_content, \
_ = minmax_scale_flair_content(X_valid_flair_content,
                               y_valid_flair_content,
                               normalizers_flair_content=normalizers_flair_content
                               )

X_test_norm_flair_content, \
y_test_norm_flair_content, \
_ = minmax_scale_flair_content(X_test_flair_content,
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        y_test_flair_content,
        normalizers_flair_content=normalizers_flair_content
    )

    # Creating target (y) and "windows" (X) for modeling
    TIME_WINDOW_flair_content = 45
    FORECAST_DISTANCE_flair_content = 9

    segmenter_flair_content = SegmentXYForecast(width=TIME_WINDOW_flair_content,
                                                step=1,
                                                y_func=last,
                                                forecast=FORECAST_DISTANCE_flair_content,
                                                t
                                                )

    X_train_rolled_flair_content, \
    y_train_rolled_flair_content, \
    _ = segmenter_flair_content.fit_transform([X_train_norm_flair_content.values],
                                             [y_train_norm_flair_content.flatten()])

    X_valid_rolled_flair_content, \
    y_valid_rolled_flair_content, \
    _ = segmenter_flair_content.fit_transform([X_valid_norm_flair_content.values],
                                             [y_valid_norm_flair_content.flatten()])

    X_test_rolled_flair_content, \
    y_test_rolled_flair_content, \
    _ = segmenter_flair_content.fit_transform([X_test_norm_flair_content.values],
                                             [y_test_norm_flair_content.flatten()])

    shape_flair_content = X_train_rolled_flair_content.shape
    X_train_flattened_flair_content = X_train_rolled_flair_content.reshape(shape_flair_content[0],
                                                                           shape_flair_content[1]*shape_flair_content[2])

    X_train_flattened_flair_content.shape
    shape_flair_content = X_valid_rolled_flair_content.shape
    X_valid_flattened_flair_content = X_valid_rolled_flair_content.reshape(shape_flair_content[0],
                                                                           shape_flair_content[1]*shape_flair_content[2])

    # XGBoost needs it's custom data format to run quickly
    dmatrix_train_flair_content = xgb.DMatrix(data=X_train_flattened_flair_content,
                                              label=y_train_rolled_flair_content)

    dmatrix_valid_flair_content = xgb.DMatrix(data=X_valid_flattened_flair_content,
                                              label=y_valid_rolled_flair_content)

    params_flair_content = {'objective': 'reg:linear', 'eval_metric': 'rmse', 'n_estimators': 30, 'tree_method': 'gpu_hist'}
    #param['nthread'] = 4
    evallist_flair_content = [(dmatrix_valid_flair_content, 'eval'), (dmatrix_train_flair_content, 'train')]

    #After some tests, it turned out to overfit after this point

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num_round_flair_content = 12

xg_reg_flair_content = xgb.train(params_flair_content,
                                  dmatrix_train_flair_content,
                                  num_round_flair_content,
                                  evallist_flair_content
                                  )

xgb_predictions_flair_content = xg_reg_flair_content.predict(dmatrix_valid_flair_content)

rms_base_flair_content = sqrt(mean_squared_error(y_valid_rolled_flair_content, xgb_predictions_flair_content))

print("Root mean squared error on valid:", rms_base_flair_content)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_flair_content["OPEN"].inverse_transform(np.array([rms_base_flair_content]).reshape(1, -1)))

all_params_flair_content = {
    # 'min_child_weight': [1, 5, 10],
    # 'gamma': [0.5, 1, 1.5, 2, 5],
    # 'subsample': [0.6, 0.8, 1.0],
    # 'colsample_bytree': [0.6, 0.8, 1.0],
    # 'max_depth': [3, 4, 5],
    'n_estimators': [30, 100, 200, 500],
    'learning_rate': [0.01, 0.1, 0.2, 0.3],
    'objective': ['reg:linear'],
    'eval_metric': ['rmse'],
    'tree_method': ['gpu_hist'],
}

best_score_flair_content = 10000.0
run_flair_content = 1

evallist_flair_content = [(dmatrix_valid_flair_content, 'eval'), (dmatrix_train_flair_content, 'train')]
for param_sample_flair_content in ParameterGrid(all_params_flair_content):
    print("----RUN ", run_flair_content)
    xg_reg_flair_content = xgb.train(param_sample_flair_content,
                                      dmatrix_train_flair_content,
                                      num_round_flair_content * 3,
                                      evallist_flair_content)

    xgb_predictions_flair_content = xg_reg_flair_content.predict(dmatrix_valid_flair_content)
    score_flair_content = sqrt(mean_squared_error(y_valid_rolled_flair_content, xgb_predictions_flair_content))

    if score_flair_content < best_score_flair_content:
        best_score_flair_content = score_flair_content
        best_model_flair_content = xg_reg_flair_content
        run_flair_content += 1

print("Root mean squared error on valid:", best_score_flair_content)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_flair_content["OPEN"].inverse_transform(np.array([best_score_flair_content]).reshape(1, -1)))

print("-----")
print(' ')

xgboost_price_prediction_flair_content = normalizers_flair_content['OPEN'].inverse_transform(np.array(xgb_predictions_flair_content).reshape(-1, 1))

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print(xgboost_price_prediction_flair_content)

print("-----")
print("-----")

new_df_flair_header = concatenate_dataframe(['OPEN',
                                             'HIGH',
                                             'LOW',
                                             'CLOSE',
                                             'VOLUME',
                                             'flair_sentiment_header_score'])

new_df_flair_header = new_df_flair_header.fillna(0)
# new_df[['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'flair_sentiment_header_score
']].astype(np.float64)
# print(new_df)

# train, valid, test split
valid_test_size_split_flair_header = 0.1

X_train_flair_header, \
X_else_flair_header, \
y_train_flair_header, \
y_else_flair_header = train_test_split(new_df_flair_header,
                                       new_df_flair_header['OPEN'],
                                       test_size=valid_test_size_split_flair_header
                                       *2,
                                       shuffle=False
                                       )

X_valid_flair_header, \
X_test_flair_header, \
y_valid_flair_header, \
y_test_flair_header = train_test_split(X_else_flair_header,
                                       y_else_flair_header,
                                       test_size=0.5,
                                       shuffle=False
                                       )

#print(y_else_flair_header)
warnings.filterwarnings(action='ignore', category=DataConversionWarning)

# normalize data
def minmax_scale_flair_header(df_x, series_y, normalizers_flair_header = None):
    features_to_minmax = ['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'flair_sentimen
t_header_score']

    if not normalizers_flair_header:
        normalizers_flair_header = {}

    for feat in features_to_minmax:
        if feat not in normalizers_flair_header:
            normalizers_flair_header[feat] = MinMaxScaler()
            normalizers_flair_header[feat].fit(df_x[feat].values.reshape(-1, 1))

        df_x[feat] = normalizers_flair_header[feat].transform(df_x[feat].values.res
hape(-1, 1))

    series_y = normalizers_flair_header['OPEN'].transform(series_y.values.reshape(-
1, 1))

    return df_x, series_y, normalizers_flair_header

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X_train_norm_flair_header, \
y_train_norm_flair_header, \
normalizers_flair_header = minmax_scale_flair_header(X_train_flair_header,
                                                    y_train_flair_header
                                                    )

X_valid_norm_flair_header, \
y_valid_norm_flair_header, \
_ = minmax_scale_flair_header(X_valid_flair_header,
                              y_valid_flair_header,
                              normalizers_flair_header=normalizers_flair_header
                              )

X_test_norm_flair_header, \
y_test_norm_flair_header, \
_ = minmax_scale_flair_header(X_test_flair_header,
                              y_test_flair_header,
                              normalizers_flair_header=normalizers_flair_header
                              )

# Creating target (y) and "windows" (X) for modeling
TIME_WINDOW_flair_header = 45
FORECAST_DISTANCE_flair_header = 9

segmenter_flair_header = SegmentXYForecast(width=TIME_WINDOW_flair_header,
                                           step=1,
                                           y_func=last,
                                           forecast=FORECAST_DISTANCE_flair_header
                                           )

X_train_rolled_flair_header, \
y_train_rolled_flair_header, \
_ = segmenter_flair_header.fit_transform([X_train_norm_flair_header.values],
                                         [y_train_norm_flair_header.flatten()])

X_valid_rolled_flair_header, \
y_valid_rolled_flair_header, \
_ = segmenter_flair_header.fit_transform([X_valid_norm_flair_header.values],
                                         [y_valid_norm_flair_header.flatten()])

X_test_rolled_flair_header, \
y_test_rolled_flair_header, \
_ = segmenter_flair_header.fit_transform([X_test_norm_flair_header.values],
                                         [y_test_norm_flair_header.flatten()])

shape_flair_header = X_train_rolled_flair_header.shape
X_train_flattened_flair_header = X_train_rolled_flair_header.reshape(shape_flair_header[0],
                                                                    shape_flair_header[1]*shape_flair_header[2])

X_train_flattened_flair_header.shape
shape_flair_header = X_valid_rolled_flair_header.shape
X_valid_flattened_flair_header = X_valid_rolled_flair_header.reshape(shape_flair_header[0],
                                                                    shape_flair_header[1]*shape_flair_header[2])

X_train_flattened_flair_header.shape
X_valid_flattened_flair_header.shape
X_test_flattened_flair_header = X_test_rolled_flair_header.reshape(shape_flair_header[0],
                                                                    shape_flair_header[1]*shape_flair_header[2])

# XGBoost needs it's custom data format to run quickly

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```
dmatrix_train_flair_header = xgb.DMatrix(data=X_train_flattened_flair_header,
                                          label=y_train_rolled_flair_header
                                          )

dmatrix_valid_flair_header = xgb.DMatrix(data=X_valid_flattened_flair_header,
                                          label=y_valid_rolled_flair_header
                                          )

params_flair_header = {'objective': 'reg:linear', 'eval_metric': 'rmse', 'n_estimators': 30, 'tree_method': 'gpu_hist'}
#param['nthread'] = 4
evallist_flair_header = [(dmatrix_valid_flair_header, 'eval'), (dmatrix_train_flair_header, 'train')]

#After some tests, it turned out to overfit after this point
num_round_flair_header = 12

xg_reg_flair_header = xgb.train(params_flair_header,
                                dmatrix_train_flair_header,
                                num_round_flair_header,
                                evallist_flair_header
                                )

xgb_predictions_flair_header = xg_reg_flair_header.predict(dmatrix_valid_flair_header)

rms_base_flair_header = sqrt(mean_squared_error(y_valid_rolled_flair_header, xgb_predictions_flair_header))

print("Root mean squared error on valid:", rms_base_flair_header)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_flair_header["OPEN"].inverse_transform(np.array([rms_base_flair_header]).reshape(1, -1)))

all_params_flair_header = {
    # 'min_child_weight': [1, 5, 10],
    # 'gamma': [0.5, 1, 1.5, 2, 5],
    # 'subsample': [0.6, 0.8, 1.0],
    # 'colsample_bytree': [0.6, 0.8, 1.0],
    # 'max_depth': [3, 4, 5],
    'n_estimators': [30, 100, 200, 500],
    'learning_rate': [0.01, 0.1, 0.2, 0.3],
    'objective': ['reg:linear'],
    'eval_metric': ['rmse'],
    'tree_method': ['gpu_hist'],
}

best_score_flair_header = 10000.0
run_flair_header = 1

evallist_flair_header = [(dmatrix_valid_flair_header, 'eval'), (dmatrix_train_flair_header, 'train')]
for param_sample_flair_header in ParameterGrid(all_params_flair_header):
    print("----RUN ", run_flair_header)
    xg_reg_flair_header = xgb.train(param_sample_flair_header,
                                    dmatrix_train_flair_header,
                                    num_round_flair_header * 3,
                                    evallist_flair_header)

    xgb_predictions_flair_header = xg_reg_flair_header.predict(dmatrix_valid_flair_header)
    score_flair_header = sqrt(mean_squared_error(y_valid_rolled_flair_header, xgb_predictions_flair_header))
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    if score_flair_header < best_score_flair_header:
        best_score_flair_header = score_flair_header
        best_model_flair_header = xg_reg_flair_header
    run_flair_header += 1

print("Root mean squared error on valid:", best_score_flair_header)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_flair_header["OPEN"].inverse_transform(np.array([best_score_flair_header]).reshape(1, -1)))

print("-----")
print(' ')

xgboost_price_prediction_flair_header = normalizers_flair_header['OPEN'].inverse_transform(np.array(xgb_predictions_flair_header).reshape(-1, 1))

print(xgboost_price_prediction_flair_header)

print("-----")
print("-----")

new_df_textblob_content = concatenate_dataframe[['OPEN',
                                                'HIGH',
                                                'LOW',
                                                'CLOSE',
                                                'VOLUME',
                                                'polarity_textblob_sentiment_content']]

new_df_textblob_content = new_df_textblob_content.fillna(0)
# new_df[['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'polarity_textblob_sentiment_content']].astype(np.float64)
# print(new_df)

# train, valid, test split
valid_test_size_split_textblob_content = 0.1

X_train_textblob_content, \
X_else_textblob_content, \
y_train_textblob_content, \
y_else_textblob_content = train_test_split(new_df_textblob_content,
                                          new_df_textblob_content['OPEN'],
                                          test_size=valid_test_size_split_textblob_content*2,
                                          shuffle=False
                                          )

X_valid_textblob_content, \
X_test_textblob_content, \
y_valid_textblob_content, \
y_test_textblob_content = train_test_split(X_else_textblob_content,
                                          y_else_textblob_content,
                                          test_size=0.5,
                                          shuffle=False
                                          )

#print(y_else_textblob_content)
warnings.filterwarnings(action='ignore', category=DataConversionWarning)

# normalize data
def minmax_scale_textblob_content(df_x, series_y, normalizers_textblob_content = None):
    features_to_minmax = ['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'polarity_textblob_sentiment_content']

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    if not normalizers_textblob_content:
        normalizers_textblob_content = {}

    for feat in features_to_minmax:
        if feat not in normalizers_textblob_content:
            normalizers_textblob_content[feat] = MinMaxScaler()
            normalizers_textblob_content[feat].fit(df_x[feat].values.reshape(-1,
1))

            df_x[feat] = normalizers_textblob_content[feat].transform(df_x[feat].value
s.reshape(-1, 1))

        series_y = normalizers_textblob_content['OPEN'].transform(series_y.values.resha
pe(-1, 1))

    return df_x, series_y, normalizers_textblob_content

X_train_norm_textblob_content, \
y_train_norm_textblob_content, \
normalizers_textblob_content = minmax_scale_textblob_content(X_train_textblob_conte
nt,
                                                                y_train_textblob_conte
nt

X_valid_norm_textblob_content, \
y_valid_norm_textblob_content, \
_ = minmax_scale_textblob_content(X_valid_textblob_content,
                                y_valid_textblob_content,
                                normalizers_textblob_content=normalizers_textblob
_content

X_test_norm_textblob_content, \
y_test_norm_textblob_content, \
_ = minmax_scale_textblob_content(X_test_textblob_content,
                                y_test_textblob_content,
                                normalizers_textblob_content=normalizers_textblob
_content

# Creating target (y) and "windows" (X) for modeling
TIME_WINDOW_textblob_content = 45
FORECAST_DISTANCE_textblob_content = 9

segmenter_textblob_content = SegmentXYForecast(width=TIME_WINDOW_textblob_content,
                                                step=1,
                                                y_func=last,
                                                forecast=FORECAST_DISTANCE_textblob_
content

X_train_rolled_textblob_content, \
y_train_rolled_textblob_content, \
_ = segmenter_textblob_content.fit_transform([X_train_norm_textblob_content.value
s],
                                            [y_train_norm_textblob_content.flatten
()])

X_valid_rolled_textblob_content, \
y_valid_rolled_textblob_content, \
_ = segmenter_textblob_content.fit_transform([X_valid_norm_textblob_content.value

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s],
                                [y_valid_norm_textblob_content.flatten
()]
                                )

X_test_rolled_textblob_content, \
y_test_rolled_textblob_content, \
_ = segmenter_textblob_content.fit_transform([X_test_norm_textblob_content.values],
                                [y_test_norm_textblob_content.flatten
()])
                                )

shape_textblob_content = X_train_rolled_textblob_content.shape
X_train_flattened_textblob_content = X_train_rolled_textblob_content.reshape(shape_
textblob_content[0],
                                shape_
textblob_content[1]*shape_textblob_content[2]
                                )

X_train_flattened_textblob_content.shape
shape_textblob_content = X_valid_rolled_textblob_content.shape
X_valid_flattened_textblob_content = X_valid_rolled_textblob_content.reshape(shape_
textblob_content[0],
                                shape_
textblob_content[1]*shape_textblob_content[2]
                                )

# XGBoost needs it's custom data format to run quickly
dmatrix_train_textblob_content = xgb.DMatrix(data=X_train_flattened_textblob_conten
t,
                                label=y_train_rolled_textblob_content
                                )

dmatrix_valid_textblob_content = xgb.DMatrix(data=X_valid_flattened_textblob_conten
t,
                                label=y_valid_rolled_textblob_content
                                )

params_textblob_content = {'objective': 'reg:linear', 'eval_metric': 'rmse', 'n_est
imators': 30, 'tree_method': 'gpu_hist'}
#param['nthread'] = 4
evallist_textblob_content = [(dmatrix_valid_textblob_content, 'eval'), (dmatrix_tra
in_textblob_content, 'train')]

#After some tests, it turned out to overfit after this point
num_round_textblob_content = 12

xg_reg_textblob_content = xgb.train(params_textblob_content,
                                dmatrix_train_textblob_content,
                                num_round_textblob_content,
                                evallist_textblob_content
                                )

xgb_predictions_textblob_content = xg_reg_textblob_content.predict(dmatrix_valid_te
xtblob_content)

rms_base_textblob_content = sqrt(mean_squared_error(y_valid_rolled_textblob_conten
t, xgb_predictions_textblob_content))

print("Root mean squared error on valid:", rms_base_textblob_content)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_textblob_content["OPEN"].inverse_transform(np.array([rms_base_tex
tblob_content]).reshape(1, -1)))

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all_params_textblob_content = {
    # 'min_child_weight': [1, 5, 10],
    # 'gamma': [0.5, 1, 1.5, 2, 5],
    # 'subsample': [0.6, 0.8, 1.0],
    # 'colsample_bytree': [0.6, 0.8, 1.0],
    # 'max_depth': [3, 4, 5],
    'n_estimators': [30, 100, 200, 500],
    'learning_rate': [0.01, 0.1, 0.2, 0.3],
    'objective': ['reg:linear'],
    'eval_metric': ['rmse'],
    'tree_method': ['gpu_hist'],
}

best_score_textblob_content = 10000.0
run_textblob_content = 1

evallist_textblob_content = [(dmatrix_valid_textblob_content, 'eval'), (dmatrix_train_textblob_content, 'train')]
for param_sample_textblob_content in ParameterGrid(all_params_textblob_content):
    print("----RUN ", run_textblob_content)
    xg_reg_textblob_content = xgb.train(param_sample_textblob_content,
                                       dmatrix_train_textblob_content,
                                       num_round_textblob_content * 3,
                                       evallist_textblob_content)

    xgb_predictions_textblob_content = xg_reg_textblob_content.predict(dmatrix_valid_textblob_content)
    score_textblob_content = sqrt(mean_squared_error(y_valid_rolled_textblob_content, xgb_predictions_textblob_content))

    if score_textblob_content < best_score_textblob_content:
        best_score_textblob_content = score_textblob_content
        best_model_textblob_content = xg_reg_textblob_content
        run_textblob_content += 1

print("Root mean squared error on valid:", best_score_textblob_content)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_textblob_content["OPEN"].inverse_transform(np.array([best_score_textblob_content]).reshape(1, -1)))

print("-----")
print(' ')

xgboost_price_prediction_textblob_content = normalizers_textblob_content["OPEN"].inverse_transform(np.array(xgb_predictions_textblob_content).reshape(-1, 1))

print(xgboost_price_prediction_textblob_content)

print("-----")
print("-----")

new_df_textblob_header = concatenate_dataframe(['OPEN',
                                              'HIGH',
                                              'LOW',
                                              'CLOSE',
                                              'VOLUME',
                                              'polarity_textblob_sentiment_header'
                                              ])

new_df_textblob_header = new_df_textblob_header.fillna(0)
# new_df[['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'polarity_textblob_sentiment_header']].astype(np.float64)
# print(new_df)

```

```

# train, valid, test split
valid_test_size_split_textblob_header = 0.1

X_train_textblob_header, \
X_else_textblob_header, \
y_train_textblob_header, \
y_else_textblob_header = train_test_split(new_df_textblob_header,
                                          new_df_textblob_header['OPEN'],
                                          test_size=valid_test_size_split_textblob_
header*2,
                                          shuffle=False
                                          )

X_valid_textblob_header, \
X_test_textblob_header, \
y_valid_textblob_header, \
y_test_textblob_header = train_test_split(X_else_textblob_header,
                                          y_else_textblob_header,
                                          test_size=0.5,
                                          shuffle=False
                                          )

#print(y_else_textblob_header)
warnings.filterwarnings(action='ignore', category=DataConversionWarning)

# normalize data
def minmax_scale_textblob_header(df_x, series_y, normalizers_textblob_header = Non
e):
    features_to_minmax = ['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'polarity_textb
lob_sentiment_header']

    if not normalizers_textblob_header:
        normalizers_textblob_header = {}

    for feat in features_to_minmax:
        if feat not in normalizers_textblob_header:
            normalizers_textblob_header[feat] = MinMaxScaler()
            normalizers_textblob_header[feat].fit(df_x[feat].values.reshape(-1, 1))

        df_x[feat] = normalizers_textblob_header[feat].transform(df_x[feat].values.
reshape(-1, 1))

        series_y = normalizers_textblob_header['OPEN'].transform(series_y.values.reshap
e(-1, 1))

    return df_x, series_y, normalizers_textblob_header

X_train_norm_textblob_header, \
y_train_norm_textblob_header, \
normalizers_textblob_header = minmax_scale_textblob_header(X_train_textblob_header,
                                                            y_train_textblob_header
                                                            )

X_valid_norm_textblob_header, \
y_valid_norm_textblob_header, \
_ = minmax_scale_textblob_header(X_valid_textblob_header,
                                y_valid_textblob_header,
                                normalizers_textblob_header=normalizers_textblob_h
eader
                                )

X_test_norm_textblob_header, \
y_test_norm_textblob_header, \

```

```

_ = minmax_scale_textblob_header(X_test_textblob_header,
                                y_test_textblob_header,
                                normalizers_textblob_header=normalizers_textblob_header)

# Creating target (y) and "windows" (X) for modeling
TIME_WINDOW_textblob_header = 45
FORECAST_DISTANCE_textblob_header = 9

segmenter_textblob_header = SegmentXYForecast(width=TIME_WINDOW_textblob_header,
                                                step=1,
                                                y_func=last,
                                                forecast=FORECAST_DISTANCE_textblob_header)

X_train_rolled_textblob_header, \
y_train_rolled_textblob_header, \
_ = segmenter_textblob_header.fit_transform([X_train_norm_textblob_header.values],
                                           [y_train_norm_textblob_header.flatten()])

X_valid_rolled_textblob_header, \
y_valid_rolled_textblob_header, \
_ = segmenter_textblob_header.fit_transform([X_valid_norm_textblob_header.values],
                                           [y_valid_norm_textblob_header.flatten()])

X_test_rolled_textblob_header, \
y_test_rolled_textblob_header, \
_ = segmenter_textblob_header.fit_transform([X_test_norm_textblob_header.values],
                                           [y_test_norm_textblob_header.flatten()])

shape_textblob_header = X_train_rolled_textblob_header.shape
X_train_flattened_textblob_header = X_train_rolled_textblob_header.reshape(shape_textblob_header[0],
                                                                            shape_textblob_header[1]*shape_textblob_header[2])

X_train_flattened_textblob_header.shape
shape_textblob_header = X_valid_rolled_textblob_header.shape
X_valid_flattened_textblob_header = X_valid_rolled_textblob_header.reshape(shape_textblob_header[0],
                                                                            shape_textblob_header[1]*shape_textblob_header[2])

# XGBoost needs it's custom data format to run quickly
dmatrix_train_textblob_header = xgb.DMatrix(data=X_train_flattened_textblob_header,
                                             label=y_train_rolled_textblob_header)

dmatrix_valid_textblob_header = xgb.DMatrix(data=X_valid_flattened_textblob_header,
                                             label=y_valid_rolled_textblob_header)

params_textblob_header = {'objective': 'reg:linear', 'eval_metric': 'rmse', 'n_estimators': 30, 'tree_method': 'gpu_hist'}
#param['nthread'] = 4

```

```
evallist_textblob_header = [(dmatrix_valid_textblob_header, 'eval'), (dmatrix_train_textblob_header, 'train')]

#After some tests, it turned out to overfit after this point
num_round_textblob_header = 12

xg_reg_textblob_header = xgb.train(params_textblob_header,
                                   dmatrix_train_textblob_header,
                                   num_round_textblob_header,
                                   evallist_textblob_header
                                   )

xgb_predictions_textblob_header = xg_reg_textblob_header.predict(dmatrix_valid_textblob_header)

rms_base_textblob_header = sqrt(mean_squared_error(y_valid_rolled_textblob_header,
xgb_predictions_textblob_header))

print("Root mean squared error on valid:", rms_base_textblob_header)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_textblob_header["OPEN"].inverse_transform(np.array([rms_base_textblob_header]).reshape(1, -1)))

all_params_textblob_header = {
    # 'min_child_weight': [1, 5, 10],
    # 'gamma': [0.5, 1, 1.5, 2, 5],
    # 'subsample': [0.6, 0.8, 1.0],
    # 'colsample_bytree': [0.6, 0.8, 1.0],
    # 'max_depth': [3, 4, 5],
    'n_estimators': [30, 100, 200, 500],
    'learning_rate': [0.01, 0.1, 0.2, 0.3],
    'objective': ['reg:linear'],
    'eval_metric': ['rmse'],
    'tree_method': ['gpu_hist'],
}

best_score_textblob_header = 10000.0
run_textblob_header = 1

evallist_textblob_header = [(dmatrix_valid_textblob_header, 'eval'), (dmatrix_train_textblob_header, 'train')]
for param_sample_textblob_header in ParameterGrid(all_params_textblob_header):
    print("----RUN ", run_textblob_header)
    xg_reg_textblob_header = xgb.train(param_sample_textblob_header,
                                       dmatrix_train_textblob_header,
                                       num_round_textblob_header * 3,
                                       evallist_textblob_header
                                       )

    xgb_predictions_textblob_header = xg_reg_textblob_header.predict(dmatrix_valid_textblob_header)
    score_textblob_header = sqrt(mean_squared_error(y_valid_rolled_textblob_header,
xgb_predictions_textblob_header))

    if score_textblob_header < best_score_textblob_header:
        best_score_textblob_header = score_textblob_header
        best_model_textblob_header = xg_reg_textblob_header
        run_textblob_header += 1

print("Root mean squared error on valid:", best_score_textblob_header)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_textblob_header["OPEN"].inverse_transform(np.array([best_score_textblob_header]).reshape(1, -1)))
```

```

print("-----")
print(' ')

xgboost_price_prediction_textblob_header = normalizers_textblob_header['OPEN'].inverse_transform(np.array(xgb_predictions_textblob_header).reshape(-1, 1))

print(xgboost_price_prediction_textblob_header)

print("-----")
print("-----")

new_df_vader_content = concatenate_dataframe[['OPEN',
                                             'HIGH',
                                             'LOW',
                                             'CLOSE',
                                             'VOLUME',
                                             'compound_vader_articel_content']]

new_df_vader_content = new_df_vader_content.fillna(0)
# new_df[['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'compound_vader_articel_content']].astype(np.float64)
# print(new_df)

# train, valid, test split
valid_test_size_split_vader_content = 0.1

X_train_vader_content, \
X_else_vader_content, \
y_train_vader_content, \
y_else_vader_content = train_test_split(new_df_vader_content,
                                       new_df_vader_content['OPEN'],
                                       test_size=valid_test_size_split_vader_content*2,
                                       shuffle=False)

X_valid_vader_content, \
X_test_vader_content, \
y_valid_vader_content, \
y_test_vader_content = train_test_split(X_else_vader_content,
                                       y_else_vader_content,
                                       test_size=0.5,
                                       shuffle=False)

#print(y_else_vader_content)
warnings.filterwarnings(action='ignore', category=DataConversionWarning)

# normalize data
def minmax_scale_vader_content(df_x, series_y, normalizers_vader_content = None):
    features_to_minmax = ['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'compound_vader_articel_content']

    if not normalizers_vader_content:
        normalizers_vader_content = {}

    for feat in features_to_minmax:
        if feat not in normalizers_vader_content:
            normalizers_vader_content[feat] = MinMaxScaler()
            normalizers_vader_content[feat].fit(df_x[feat].values.reshape(-1, 1))

        df_x[feat] = normalizers_vader_content[feat].transform(df_x[feat].values.reshape(-1, 1))

```

```

        series_y = normalizers_vader_content['OPEN'].transform(series_y.values.reshape
(-1, 1))

    return df_x, series_y, normalizers_vader_content

X_train_norm_vader_content, \
y_train_norm_vader_content, \
normalizers_vader_content = minmax_scale_vader_content(X_train_vader_content,
                                                         y_train_vader_content
                                                         )

X_valid_norm_vader_content, \
y_valid_norm_vader_content, \
_ = minmax_scale_vader_content(X_valid_vader_content,
                               y_valid_vader_content,
                               normalizers_vader_content=normalizers_vader_content
                               )

X_test_norm_vader_content, \
y_test_norm_vader_content, \
_ = minmax_scale_vader_content(X_test_vader_content,
                               y_test_vader_content,
                               normalizers_vader_content=normalizers_vader_content
                               )

# Creating target (y) and "windows" (X) for modeling
TIME_WINDOW_vader_content = 45
FORECAST_DISTANCE_vader_content = 9

segmenter_vader_content = SegmentXYForecast(width=TIME_WINDOW_vader_content,
                                             step=1,
                                             y_func=last,
                                             forecast=FORECAST_DISTANCE_vader_content
                                             )

X_train_rolled_vader_content, \
y_train_rolled_vader_content, \
_ = segmenter_vader_content.fit_transform([X_train_norm_vader_content.values],
                                         [y_train_norm_vader_content.flatten()])

X_valid_rolled_vader_content, \
y_valid_rolled_vader_content, \
_ = segmenter_vader_content.fit_transform([X_valid_norm_vader_content.values],
                                         [y_valid_norm_vader_content.flatten()])

X_test_rolled_vader_content, \
y_test_rolled_vader_content, \
_ = segmenter_vader_content.fit_transform([X_test_norm_vader_content.values],
                                         [y_test_norm_vader_content.flatten()])

shape_vader_content = X_train_rolled_vader_content.shape
X_train_flattened_vader_content = X_train_rolled_vader_content.reshape(shape_vader_
content[0],
                                                                    shape_vader_
content[1]*shape_vader_content[2]
                                                                    )

X_train_flattened_vader_content.shape
shape_vader_content = X_valid_rolled_vader_content.shape
X_valid_flattened_vader_content = X_valid_rolled_vader_content.reshape(shape_vader_

```



```

content[0],
                                                    shape_vader_
content[1]*shape_vader_content[2]
                                                    )

# XGBoost needs it's custom data format to run quickly
dmatrix_train_vader_content = xgb.DMatrix(data=X_train_flattened_vader_content,
                                           label=y_train_rolled_vader_content
                                           )

dmatrix_valid_vader_content = xgb.DMatrix(data=X_valid_flattened_vader_content,
                                           label=y_valid_rolled_vader_content
                                           )

params_vader_content = {'objective': 'reg:linear', 'eval_metric': 'rmse', 'n_estima
tors': 30, 'tree_method': 'gpu_hist'}
#param['nthread'] = 4
evallist_vader_content = [(dmatrix_valid_vader_content, 'eval'), (dmatrix_train_vad
er_content, 'train')]

#After some tests, it turned out to overfit after this point
num_round_vader_content = 12

xg_reg_vader_content = xgb.train(params_vader_content,
                                dmatrix_train_vader_content,
                                num_round_vader_content,
                                evallist_vader_content
                                )

xgb_predictions_vader_content = xg_reg_vader_content.predict(dmatrix_valid_vader_co
ntent)

rms_base_vader_content = sqrt(mean_squared_error(y_valid_rolled_vader_content, xgb_
predictions_vader_content))

print("Root mean squared error on valid:", rms_base_vader_content)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_vader_content["OPEN"].inverse_transform(np.array([rms_base_vader_
content])).reshape(1, -1))

all_params_vader_content = {
    # 'min_child_weight': [1, 5, 10],
    # 'gamma': [0.5, 1, 1.5, 2, 5],
    # 'subsample': [0.6, 0.8, 1.0],
    # 'colsample_bytree': [0.6, 0.8, 1.0],
    # 'max_depth': [3, 4, 5],
    'n_estimators': [30, 100, 200, 500],
    'learning_rate': [0.01, 0.1, 0.2, 0.3],
    'objective': ['reg:linear'],
    'eval_metric': ['rmse'],
    'tree_method': ['gpu_hist'],
}

best_score_vader_content = 10000.0
run_vader_content = 1

evallist_vader_content = [(dmatrix_valid_vader_content, 'eval'), (dmatrix_train_vad
er_content, 'train')]
for param_sample_vader_content in ParameterGrid(all_params_vader_content):
    print("----RUN ", run_vader_content)
    xg_reg_vader_content = xgb.train(param_sample_vader_content,
                                    dmatrix_train_vader_content,
                                    num_round_vader_content * 3,
                                    evallist_vader_content)

```

```

    xgb_predictions_vader_content = xg_reg_vader_content.predict(dmatrix_valid_vade
r_content)
    score_vader_content = sqrt(mean_squared_error(y_valid_rolled_vader_content, xgb
_predictions_vader_content))

    if score_vader_content < best_score_vader_content:
        best_score_vader_content = score_vader_content
        best_model_vader_content = xg_reg_vader_content
    run_vader_content += 1

print("Root mean squared error on valid:", best_score_vader_content)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_vader_content["OPEN"].inverse_transform(np.array([best_score_vade
r_content]).reshape(1, -1)))

print("-----")
print(' ')

xgboost_price_prediction_vader_content = normalizers_vader_content['OPEN'].inverse_
transform(np.array(xgb_predictions_vader_content).reshape(-1, 1))

print(xgboost_price_prediction_vader_content)

print("-----")
print("-----")

new_df_vader_header = concatenate_dataframe[['OPEN',
                                             'HIGH',
                                             'LOW',
                                             'CLOSE',
                                             'VOLUME',
                                             'compound_vader_header']]

new_df_vader_header = new_df_vader_header.fillna(0)
# new_df[['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'compound_vader_header']].astype
(np.float64)
# print(new_df)

# train, valid, test split
valid_test_size_split_vader_header = 0.1

X_train_vader_header, \
X_else_vader_header, \
y_train_vader_header, \
y_else_vader_header = train_test_split(new_df_vader_header,
                                       new_df_vader_header['OPEN'],
                                       test_size=valid_test_size_split_vader_header
*2,
                                       shuffle=False
                                       )

X_valid_vader_header, \
X_test_vader_header, \
y_valid_vader_header, \
y_test_vader_header = train_test_split(X_else_vader_header,
                                       y_else_vader_header,
                                       test_size=0.5,
                                       shuffle=False
                                       )

#print(y_else_vader_header)
warnings.filterwarnings(action='ignore', category=DataConversionWarning)

```

```

# normalize data
def minmax_scale_vader_header(df_x, series_y, normalizers_vader_header = None):
    features_to_minmax = ['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME', 'compound_vader_header']

    if not normalizers_vader_header:
        normalizers_vader_header = {}

    for feat in features_to_minmax:
        if feat not in normalizers_vader_header:
            normalizers_vader_header[feat] = MinMaxScaler()
            normalizers_vader_header[feat].fit(df_x[feat].values.reshape(-1, 1))

        df_x[feat] = normalizers_vader_header[feat].transform(df_x[feat].values.reshape(-1, 1))

    series_y = normalizers_vader_header['OPEN'].transform(series_y.values.reshape(-1, 1))

    return df_x, series_y, normalizers_vader_header

X_train_norm_vader_header, \
y_train_norm_vader_header, \
normalizers_vader_header = minmax_scale_vader_header(X_train_vader_header,
                                                    y_train_vader_header
                                                    )

X_valid_norm_vader_header, \
y_valid_norm_vader_header, \
_ = minmax_scale_vader_header(X_valid_vader_header,
                              y_valid_vader_header,
                              normalizers_vader_header=normalizers_vader_header
                              )

X_test_norm_vader_header, \
y_test_norm_vader_header, \
_ = minmax_scale_vader_header(X_test_vader_header,
                              y_test_vader_header,
                              normalizers_vader_header=normalizers_vader_header
                              )

# Creating target (y) and "windows" (X) for modeling
TIME_WINDOW_vader_header = 45
FORECAST_DISTANCE_vader_header = 9

segmenter_vader_header = SegmentXYForecast(width=TIME_WINDOW_vader_header,
                                           step=1,
                                           y_func=last,
                                           forecast=FORECAST_DISTANCE_vader_header
                                           )

X_train_rolled_vader_header, \
y_train_rolled_vader_header, \
_ = segmenter_vader_header.fit_transform([X_train_norm_vader_header.values],
                                         [y_train_norm_vader_header.flatten()])

X_valid_rolled_vader_header, \
y_valid_rolled_vader_header, \
_ = segmenter_vader_header.fit_transform([X_valid_norm_vader_header.values],
                                         [y_valid_norm_vader_header.flatten()])

X_test_rolled_vader_header, \

```

```

y_test_rolled_vader_header, \
_ = segmenter_vader_header.fit_transform([X_test_norm_vader_header.values],
                                          [y_test_norm_vader_header.flatten()])

shape_vader_header = X_train_rolled_vader_header.shape
X_train_flattened_vader_header = X_train_rolled_vader_header.reshape(shape_vader_header[0],
                                                                    shape_vader_header[1]*shape_vader_header[2])

X_train_flattened_vader_header.shape
shape_vader_header = X_valid_rolled_vader_header.shape
X_valid_flattened_vader_header = X_valid_rolled_vader_header.reshape(shape_vader_header[0],
                                                                    shape_vader_header[1]*shape_vader_header[2])

# XGBoost needs it's custom data format to run quickly
dmatrix_train_vader_header = xgb.DMatrix(data=X_train_flattened_vader_header,
                                          label=y_train_rolled_vader_header)

dmatrix_valid_vader_header = xgb.DMatrix(data=X_valid_flattened_vader_header,
                                          label=y_valid_rolled_vader_header)

params_vader_header = {'objective': 'reg:linear', 'eval_metric': 'rmse', 'n_estimators': 30, 'tree_method': 'gpu_hist'}
#param['nthread'] = 4
evallist_vader_header = [(dmatrix_valid_vader_header, 'eval'), (dmatrix_train_vader_header, 'train')]

#After some tests, it turned out to overfit after this point
num_round_vader_header = 12

xg_reg_vader_header = xgb.train(params_vader_header,
                                dmatrix_train_vader_header,
                                num_round_vader_header,
                                evallist_vader_header)

xgb_predictions_vader_header = xg_reg_vader_header.predict(dmatrix_valid_vader_header)

rms_base_vader_header = sqrt(mean_squared_error(y_valid_rolled_vader_header, xgb_predictions_vader_header))

print("Root mean squared error on valid:", rms_base_vader_header)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_vader_header["OPEN"].inverse_transform(np.array([rms_base_vader_header])).reshape(1, -1))

all_params_vader_header = {
    # 'min_child_weight': [1, 5, 10],
    # 'gamma': [0.5, 1, 1.5, 2, 5],
    # 'subsample': [0.6, 0.8, 1.0],
    # 'colsample_bytree': [0.6, 0.8, 1.0],
    # 'max_depth': [3, 4, 5],
    'n_estimators': [30, 100, 200, 500],
    'learning_rate': [0.01, 0.1, 0.2, 0.3],
    'objective': ['reg:linear'],

```

```

        'eval_metric': ['rmse'],
        'tree_method': ['gpu_hist'],
    }

    best_score_vader_header = 10000.0
    run_vader_header = 1

    evallist_vader_header = [(dmatrix_valid_vader_header, 'eval'), (dmatrix_train_vader_header, 'train')]
    for param_sample_vader_header in ParameterGrid(all_params_vader_header):
        print("----RUN ", run_vader_header)
        xg_reg_vader_header = xgb.train(param_sample_vader_header,
                                         dmatrix_train_vader_header,
                                         num_round_vader_header * 3,
                                         evallist_vader_header)

        xgb_predictions_vader_header = xg_reg_vader_header.predict(dmatrix_valid_vader_header)
        score_vader_header = sqrt(mean_squared_error(y_valid_rolled_vader_header, xgb_predictions_vader_header))

        if score_vader_header < best_score_vader_header:
            best_score_vader_header = score_vader_header
            best_model_vader_header = xg_reg_vader_header
            run_vader_header += 1

    print("Root mean squared error on valid:", best_score_vader_header)
    print("Root mean squared error on valid inverse transformed from normalization:",
          normalizers_vader_header["OPEN"].inverse_transform(np.array([best_score_vader_header]).reshape(1, -1)))

    print("-----")
    print(' ')

    xgboost_price_prediction_vader_header = normalizers_vader_header['OPEN'].inverse_transform(np.array(xgb_predictions_vader_header).reshape(-1, 1))

    print(xgboost_price_prediction_vader_header)

    print("-----")
    print("-----")

    new_df_without_semantics = concatenate_dataframe[['OPEN',
                                                       'HIGH',
                                                       'LOW',
                                                       'CLOSE',
                                                       'VOLUME'],]

    new_df_without_semantics = new_df_without_semantics.fillna(0)
    # new_df[['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME']].astype(np.float64)
    # print(new_df)

    # train, valid, test split
    valid_test_size_split_without_semantics = 0.1

    X_train_without_semantics, \
    X_else_without_semantics, \
    y_train_without_semantics, \
    y_else_without_semantics = train_test_split(new_df_without_semantics,
                                                new_df_without_semantics['OPEN'],
                                                test_size=valid_test_size_split_without_semantics*2,
                                                shuffle=False
                                                )

```

```

X_valid_without_semantics, \
X_test_without_semantics, \
y_valid_without_semantics, \
y_test_without_semantics = train_test_split(X_else_without_semantics,
                                             y_else_without_semantics,
                                             test_size=0.5,
                                             shuffle=False
                                             )

#print(y_else_without_semantics)
warnings.filterwarnings(action='ignore', category=DataConversionWarning)

# normalize data
def minmax_scale_without_semantics(df_x, series_y, normalizers_without_semantics =
None):
    features_to_minmax = ['OPEN', 'HIGH', 'LOW', 'CLOSE', 'VOLUME']

    if not normalizers_without_semantics:
        normalizers_without_semantics = {}

    for feat in features_to_minmax:
        if feat not in normalizers_without_semantics:
            normalizers_without_semantics[feat] = MinMaxScaler()
            normalizers_without_semantics[feat].fit(df_x[feat].values.reshape(-1,
1))

        df_x[feat] = normalizers_without_semantics[feat].transform(df_x[feat].value
s.reshape(-1, 1))

        series_y = normalizers_without_semantics['OPEN'].transform(series_y.values.resh
ape(-1, 1))

    return df_x, series_y, normalizers_without_semantics

X_train_norm_without_semantics, \
y_train_norm_without_semantics, \
normalizers_without_semantics = minmax_scale_without_semantics(X_train_without_sema
ntics,
                                                                y_train_without_sema
ntics
                                                                )

X_valid_norm_without_semantics, \
y_valid_norm_without_semantics, \
_ = minmax_scale_without_semantics(X_valid_without_semantics,
                                   y_valid_without_semantics,
                                   normalizers_without_semantics=normalizers_withou
t_semantics
                                   )

X_test_norm_without_semantics, \
y_test_norm_without_semantics, \
_ = minmax_scale_without_semantics(X_test_without_semantics,
                                   y_test_without_semantics,
                                   normalizers_without_semantics=normalizers_withou
t_semantics
                                   )

# Creating target (y) and "windows" (X) for modeling
TIME_WINDOW_without_semantics = 45
FORECAST_DISTANCE_without_semantics = 9

```

```

segmenter_without_semantics = SegmentXYForecast(width=TIME_WINDOW_without_semantics,
step=1,
y_func=last,
forecast=FORECAST_DISTANCE_without_semantics
)

X_train_rolled_without_semantics, \
y_train_rolled_without_semantics, \
_ = segmenter_without_semantics.fit_transform([X_train_norm_without_semantics.values],
[y_train_norm_without_semantics.flatten()])

X_valid_rolled_without_semantics, \
y_valid_rolled_without_semantics, \
_ = segmenter_without_semantics.fit_transform([X_valid_norm_without_semantics.values],
[y_valid_norm_without_semantics.flatten()])

X_test_rolled_without_semantics, \
y_test_rolled_without_semantics, \
_ = segmenter_without_semantics.fit_transform([X_test_norm_without_semantics.values],
[y_test_norm_without_semantics.flatten()])

shape_without_semantics = X_train_rolled_without_semantics.shape
X_train_flattened_without_semantics = X_train_rolled_without_semantics.reshape(shape_without_semantics[0],
shape_without_semantics[1]*shape_without_semantics[2])

X_train_flattened_without_semantics.shape
shape_without_semantics = X_valid_rolled_without_semantics.shape
X_valid_flattened_without_semantics = X_valid_rolled_without_semantics.reshape(shape_without_semantics[0],
shape_without_semantics[1]*shape_without_semantics[2])

# XGBoost needs it's custom data format to run quickly
dmatrix_train_without_semantics = xgb.DMatrix(data=X_train_flattened_without_semantics,
label=y_train_rolled_without_semantics)

dmatrix_valid_without_semantics = xgb.DMatrix(data=X_valid_flattened_without_semantics,
label=y_valid_rolled_without_semantics)

params_without_semantics = {'objective': 'reg:linear', 'eval_metric': 'rmse', 'n_estimators': 30, 'tree_method': 'gpu_hist'}
#param['nthread'] = 4
evallist_without_semantics = [(dmatrix_valid_without_semantics, 'eval'), (dmatrix_t

```

```

rain_without_semantics, 'train']]

#After some tests, it turned out to overfit after this point
num_round_without_semantics = 12

xgb_reg_without_semantics = xgb.train(params_without_semantics,
                                       dmatrix_train_without_semantics,
                                       num_round_without_semantics,
                                       evallist_without_semantics
                                       )

xgb_predictions_without_semantics = xgb_reg_without_semantics.predict(dmatrix_valid_
without_semantics)

rms_base_without_semantics = sqrt(mean_squared_error(y_valid_rolled_without_semanti
cs, xgb_predictions_without_semantics))

print("Root mean squared error on valid:",rms_base_without_semantics)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_without_semantics["OPEN"].inverse_transform(np.array([rms_base_wi
thout_semantics]).reshape(1, -1)))

all_params_without_semantics = {
    # 'min_child_weight': [1, 5, 10],
    # 'gamma': [0.5, 1, 1.5, 2, 5],
    # 'subsample': [0.6, 0.8, 1.0],
    # 'colsample_bytree': [0.6, 0.8, 1.0],
    # 'max_depth': [3, 4, 5],
    'n_estimators': [30, 100, 200, 500],
    'learning_rate': [0.01, 0.1, 0.2, 0.3],
    'objective': ['reg:linear'],
    'eval_metric': ['rmse'],
    'tree_method': ['gpu_hist'],
}

best_score_without_semantics = 10000.0
run_without_semantics = 1

evallist_without_semantics = [(dmatrix_valid_without_semantics, 'eval'), (dmatrix_t
rain_without_semantics, 'train')]
for param_sample_without_semantics in ParameterGrid(all_params_without_semantics):
    print("----RUN ", run_without_semantics)
    xgb_reg_without_semantics = xgb.train(param_sample_without_semantics,
                                           dmatrix_train_without_semantics,
                                           num_round_without_semantics * 3,
                                           evallist_without_semantics)

    xgb_predictions_without_semantics = xgb_reg_without_semantics.predict(dmatrix_va
lid_without_semantics)
    score_without_semantics = sqrt(mean_squared_error(y_valid_rolled_without_semant
ics, xgb_predictions_without_semantics))

    if score_without_semantics < best_score_without_semantics:
        best_score_without_semantics = score_without_semantics
        best_model_without_semantics = xgb_reg_without_semantics
        run_without_semantics += 1

print("Root mean squared error on valid:", best_score_without_semantics)
print("Root mean squared error on valid inverse transformed from normalization:",
      normalizers_without_semantics["OPEN"].inverse_transform(np.array([best_score_
without_semantics]).reshape(1, -1)))

print("-----")
print(' ')

```



```
xgboost_price_prediction_without_semantics = normalizers_without_semantics['OPEN'].
inverse_transform(np.array(xgb_predictions_without_semantics).reshape(-1, 1))

print(xgboost_price_prediction_without_semantics)

print("-----")
print("-----")

plt.figure(figsize=(10,5))
plt.plot(xgboost_price_prediction_flair_content, color='green', label='Predicted BMW
Stock Price with flair content analysis')
plt.plot(xgboost_price_prediction_flair_header, color='red', label='Predicted BMW S
tock Price with flair header analysis')
plt.plot(xgboost_price_prediction_textblob_content, color='orange', label='Predicted
d BMW Stock Price with textblob content analysis')
plt.plot(xgboost_price_prediction_textblob_header, color='blue', label='Predicted B
MW Stock Price with textblob header analysis')
plt.plot(xgboost_price_prediction_vader_content, color='cyan', label='Predicted BMW
Stock Price with vader content analysis')
plt.plot(xgboost_price_prediction_vader_header, color='magenta', label='Predicted B
MW Stock Price with vader header analysis')
plt.plot(xgboost_price_prediction_without_semantics, color='yellow', label='Predict
ed BMW Stock Price without semantics analysis')
plt.title('BMW Stock Price Prediction')
plt.xlabel('Time')
plt.ylabel('BMW Stock Price')
plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.005), borderaxespad=8)

date_today = str(datetime.now().strftime("%Y%m%d"))
plt.savefig(r'C:\Users\victo\Master_Thesis\stockprice_prediction\xgboost\bmw\hourl
y\prediction_bmw_with_all_' + date_today + '.png',
            bbox_inches="tight",
            dpi=100,
            pad_inches=1.5)

plt.show()
print('Run is finished and plot is saved!')
```