### Experimenting with xgbclassifer to perform classification

did not work well, using apple price to predict apple movement only

Using only close and lag1 to 10

* Processing: 100%|██████████| 2262/2262 [21:23<00:00, 1.76it/s]
* CPU times: total: 2h 12min 23s
* Wall time: 21min 23s
* Accuracy: 17.20%
* A graph with red and blue lines

  Description automatically generated
* A blue squares with white text

  Description automatically generated

### XGBoost to perform regression

Using only close and lag1 to 10

Processing: 100%|██████████| 2262/2262 [02:44<00:00, 13.73it/s]

Wall time: 2min 44s

A lot more faster can the classifier: from 30 mins to 3 mins

Similar accuracy Accuracy: 16.22%

A blue squares with white text

Description automatically generated

Accuracy: 16.22%

precision recall f1-score support

Moderate Downtrend 0.12 0.13 0.13 232

Moderate Uptrend 0.16 0.14 0.15 348

Slight Downtrend 0.21 0.18 0.19 464

Slight Uptrend 0.20 0.20 0.20 456

Stable 0.16 0.13 0.14 310

Strong Downtrend 0.13 0.17 0.15 218

Strong Uptrend 0.12 0.16 0.14 234

accuracy 0.16 2262

macro avg 0.16 0.16 0.16 2262

weighted avg 0.17 0.16 0.16 2262

A graph with red and blue lines

Description automatically generated

#### For now, just focus on using apple data to predict apple return.

1. To optimize the processing and ensure a more streamlined approach, we have adjusted the model to run on only 10% of the original time series data.
2. Using close price only, 1 – 20 lag close price, the accuracy 20.59%
3. After the addition of volume data, we observed an accuracy improvement. The model's accuracy decreased from 20.59% to 19.12%.

Instead of predicting next day’s return or movement, I decided to have a broader timeframe: predicting the next week movement or price. The goal of the model is to estimate the price of a stock will obtain in the following week, and by doing that, we can use the model to discover trading signal.

Xgboost model with apple price only, predicting the return 5 days (a week) after, with 5 lag close in total + current close

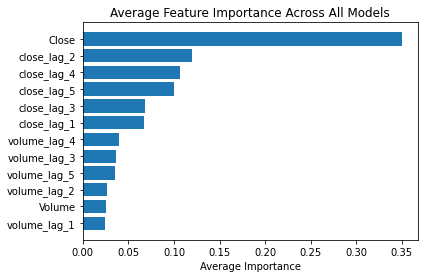
Mean Squared Error (MSE): 0.9973282042690228

Mean Absolute Percentage Error (MAPE): 2.84%

After adding volume and 5 lag volume

Mean Squared Error (MSE): 1.1600404210958313

Mean Absolute Percentage Error (MAPE): 3.12%



It seems like volume does not have much explanation power, which is counterintuitive

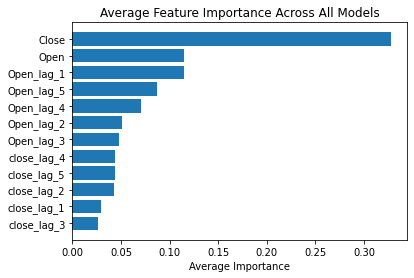
So combine volume and close price might be a good choice

After including open price and its lag price, the performance of the model slightly decreased

Mean Squared Error (MSE): 1.0266442298919725

Mean Absolute Percentage Error (MAPE): 2.93%

However: open seems also very important



Trying to add highs and lows of a day

Mean Squared Error (MSE): 1.063908647152127

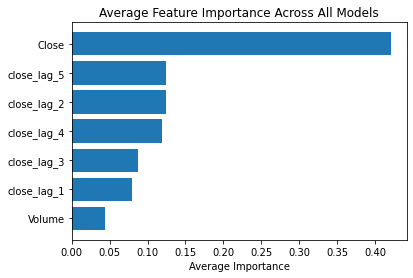
Mean Absolute Percentage Error (MAPE): 2.96%

Probability due to collinearity, so do not consider them at this moment

Added volume but not its lag; this is going to be our baseline

Mean Squared Error (MSE): 0.992164832481723

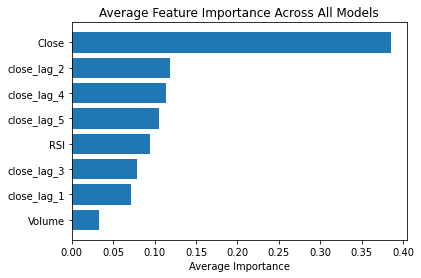
Mean Absolute Percentage Error (MAPE): 2.83%



After adding current RIS

Mean Squared Error (MSE): 0.9760073352410757

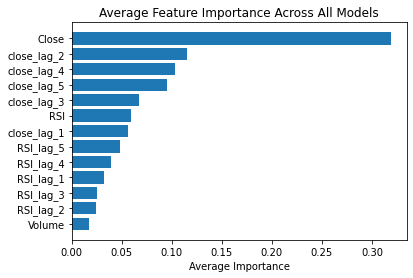
Mean Absolute Percentage Error (MAPE): 2.70%



Adding lag rsi

Mean Squared Error (MSE): 1.0700108377431683

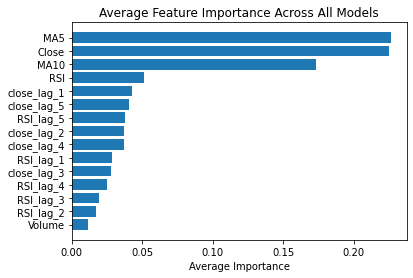
Mean Absolute Percentage Error (MAPE): 2.79%



Adding ma 5, 10

Mean Squared Error (MSE): 0.9630627719004787

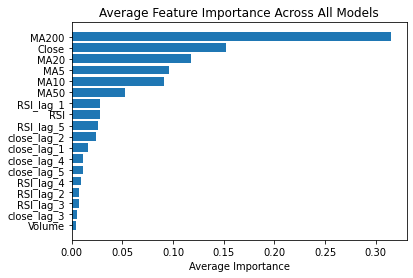
Mean Absolute Percentage Error (MAPE): 2.66%



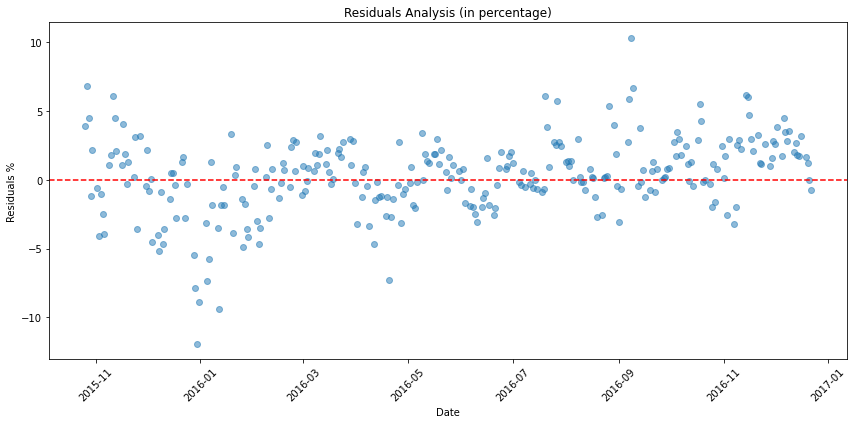
Adding all important mas, reference how to swing trade, huge improvement!!!!!!

Mean Squared Error (MSE): 0.5414648921605042

Mean Absolute Percentage Error (MAPE): 2.05%



The residual looks a lot more random than before



Adding a economic indicator, nearly no change, I expect this variables to be more powerful when there is a huge economic change (interest rate), so I am keeping it

Mean Squared Error (MSE): 0.5675471716347179

Mean Absolute Percentage Error (MAPE): 2.06%

Not using lag values for rsi

Mean Squared Error (MSE): 0.5752399599689242

Mean Absolute Percentage Error (MAPE): 2.02%

Adding a variable called green, small change

Mean Squared Error (MSE): 0.5728439463028074

Mean Absolute Percentage Error (MAPE): 2.01%

Add open close difference (open are high correlated with close)

Mean Squared Error (MSE): 0.5728439463028074

Mean Absolute Percentage Error (MAPE): 2.01%

Add high\_low\_diff \* greenday,

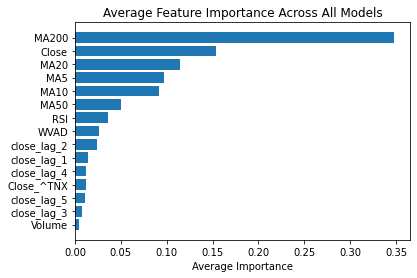
Mean Squared Error (MSE): 0.6062255531910087

Mean Absolute Percentage Error (MAPE): 2.05%

those can be covered using WVAD, removed those and added WVAD

Mean Squared Error (MSE): 0.5834007328317992

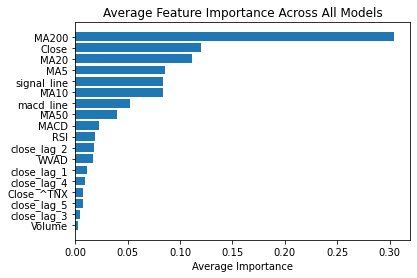
Mean Absolute Percentage Error (MAPE): 2.04%



Added macd, macd line and signal line

Mean Squared Error (MSE): 0.5025457907090828

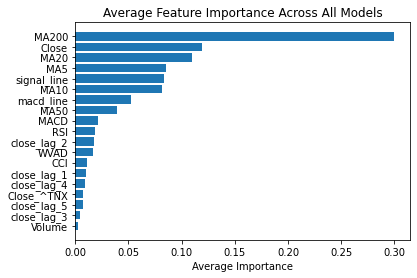
Mean Absolute Percentage Error (MAPE): 1.96%



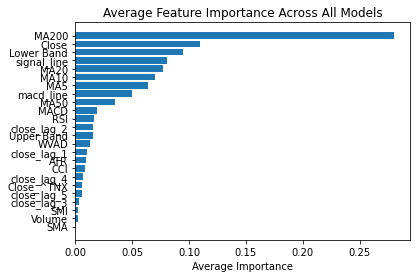
Added CCI

Mean Squared Error (MSE): 0.5008917319007433

Mean Absolute Percentage Error (MAPE): 1.95%



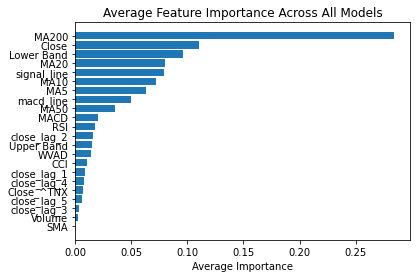
Added SMI and ATR, the model shows they are not important



Removed the previous two and Added BOLL

Mean Squared Error (MSE): 0.5331274985235674

Mean Absolute Percentage Error (MAPE): 1.93%

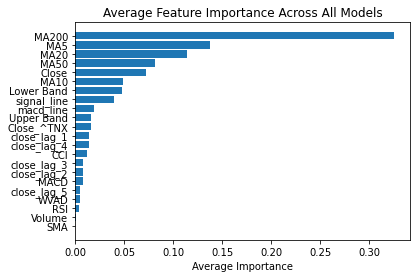


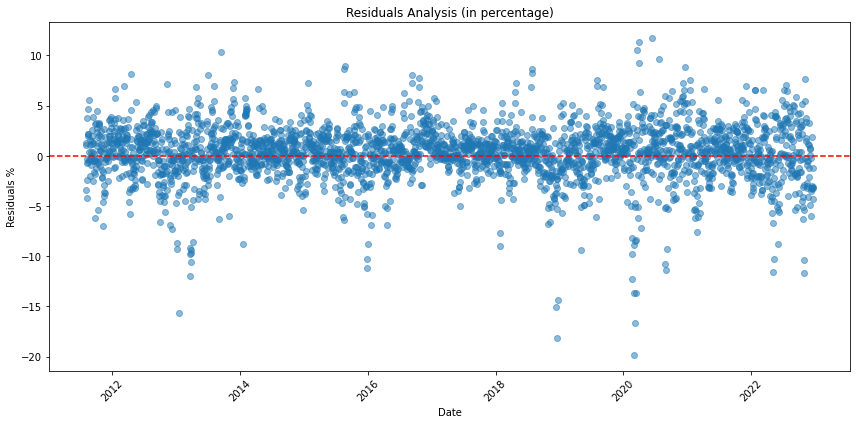
Take a break and see how to model runs on a broader time frame:

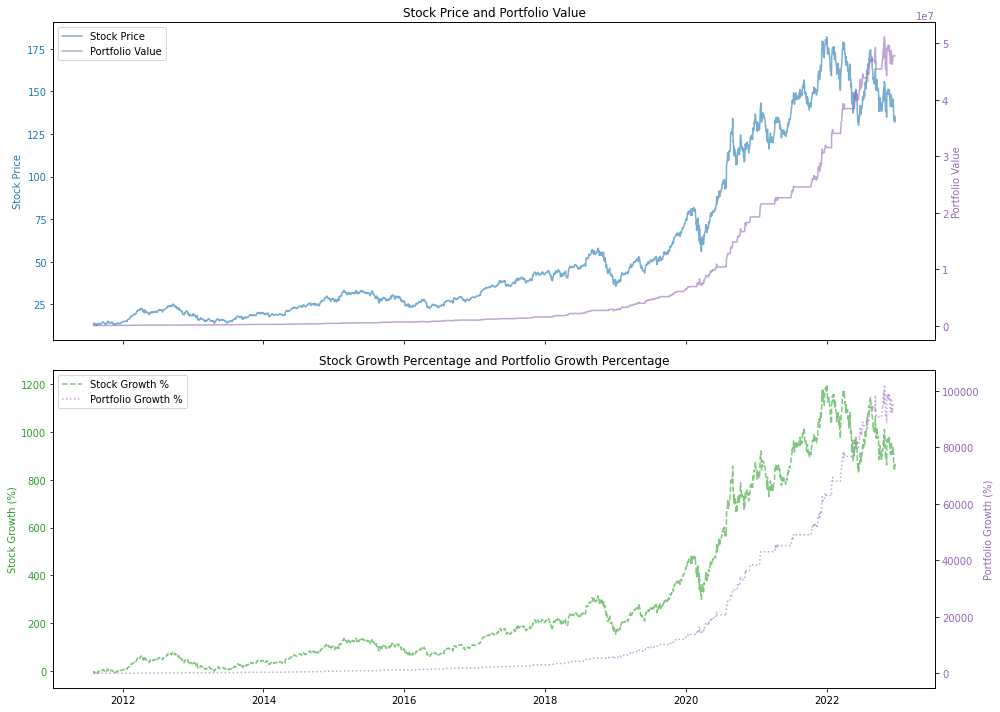
Processing: 100%|██████████| 2866/2866 [02:11<00:00, 21.72it/s]

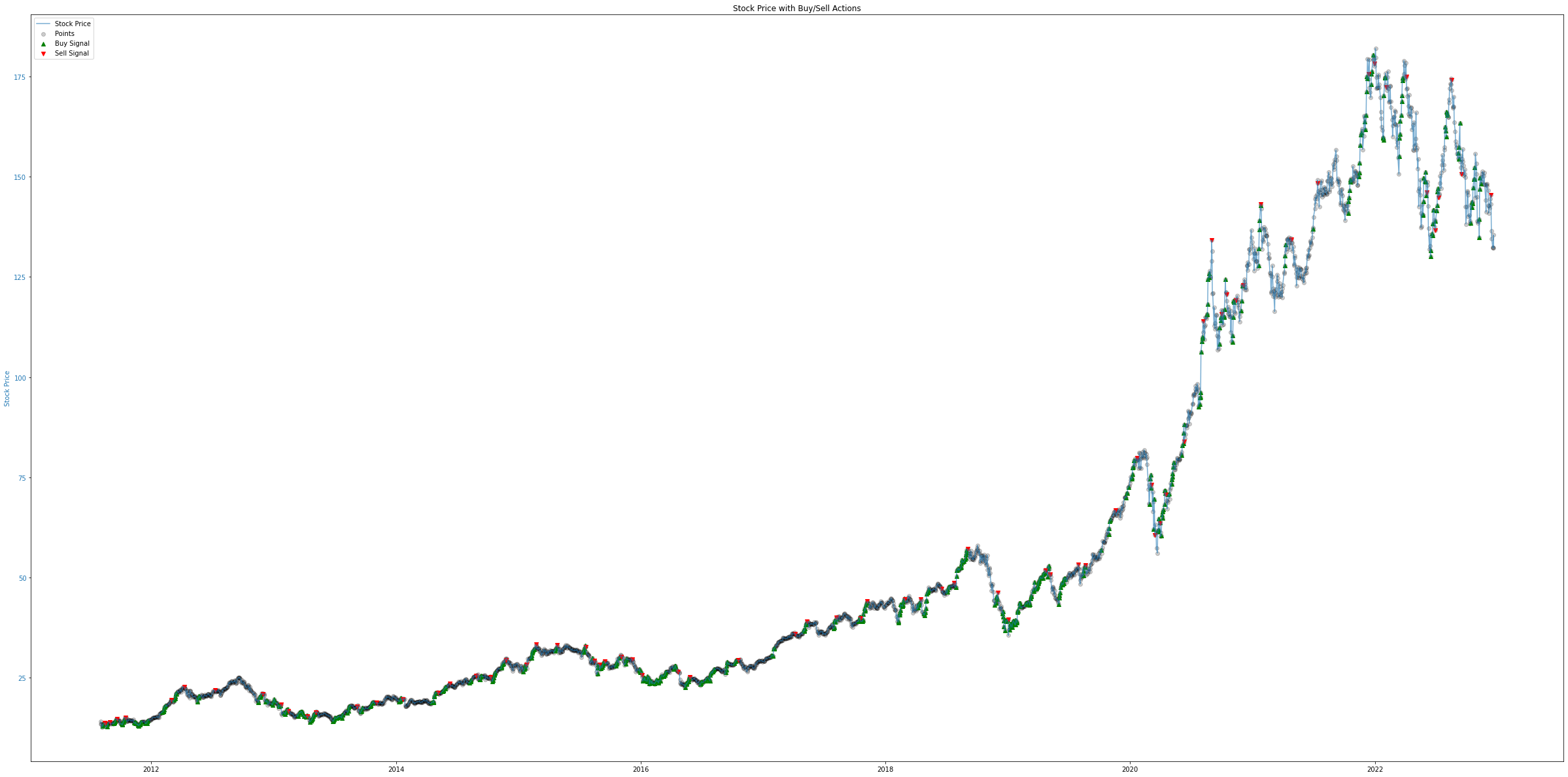
Mean Squared Error (MSE): 4.8594886373102595

Mean Absolute Percentage Error (MAPE): 1.95%









Decent at capture selling signal

Should also consider Williams vix fix and rsi bol strat

Added rsi bol strat and removed boll

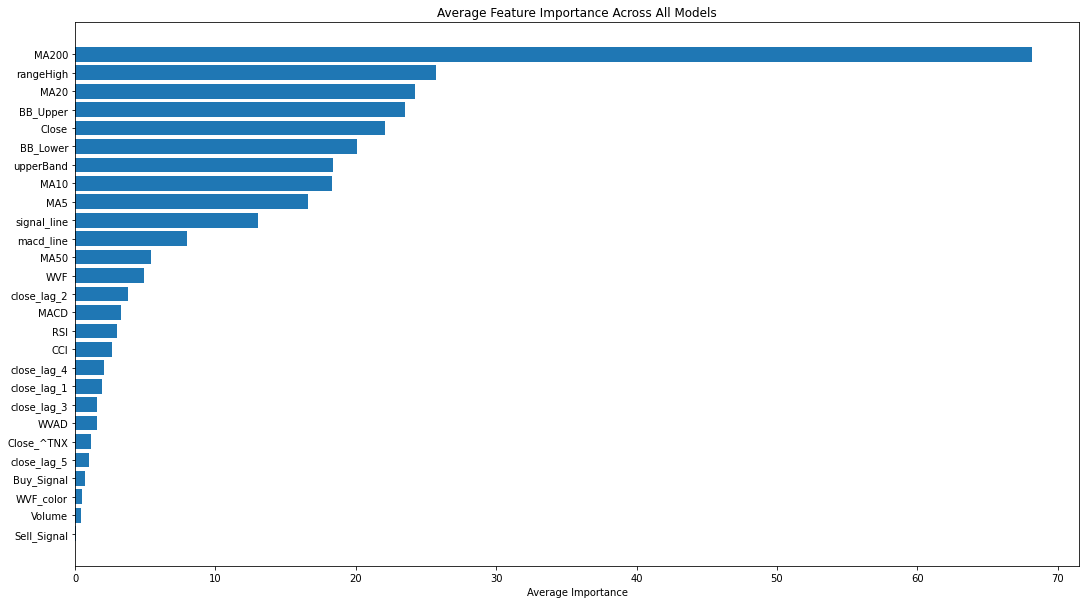
Mean Squared Error (MSE): 0.4760297325049094

Mean Absolute Percentage Error (MAPE): 1.86%

Added Williams vix fix

Mean Squared Error (MSE): 0.5386575210915088

Mean Absolute Percentage Error (MAPE): 1.88%



Adding qqq, google, etc

Mean Squared Error (MSE): 0.5950377510177521

Mean Absolute Percentage Error (MAPE): 1.99%

Ignore previous change, changing lags days to 11

Mean Squared Error (MSE): 0.47873425192524616

Mean Absolute Percentage Error (MAPE): 1.85%

Adding SPY

Mean Squared Error (MSE): 0.46099935412020426

Mean Absolute Percentage Error (MAPE): 1.75%

Adding qqq

No change

Adding dia

Mean Squared Error (MSE): 0.4713968566635163

Mean Absolute Percentage Error (MAPE): 1.79%

Ignore the previous change

Added spy qqq lag 10 days,

Mean Squared Error (MSE): 0.5109164402436346

Mean Absolute Percentage Error (MAPE): 1.88%

Not good

Next step

Deal with collinearity, add more features like the trend of other companies

Break

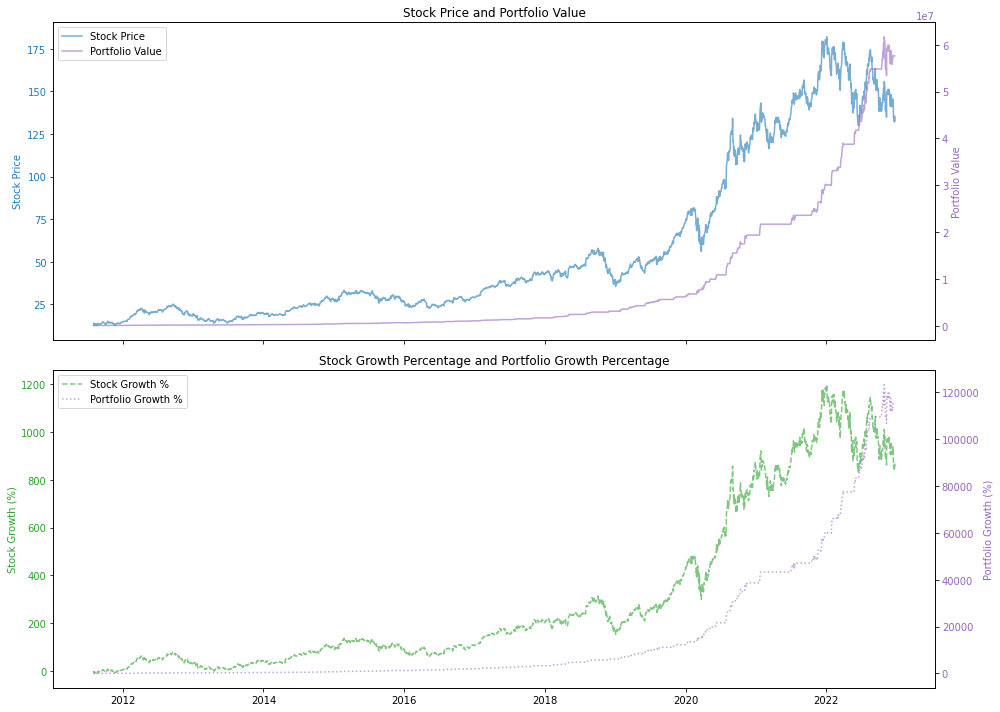
Try the model on a full-time frame, slightly better, used to be 1.95%, now 1.87

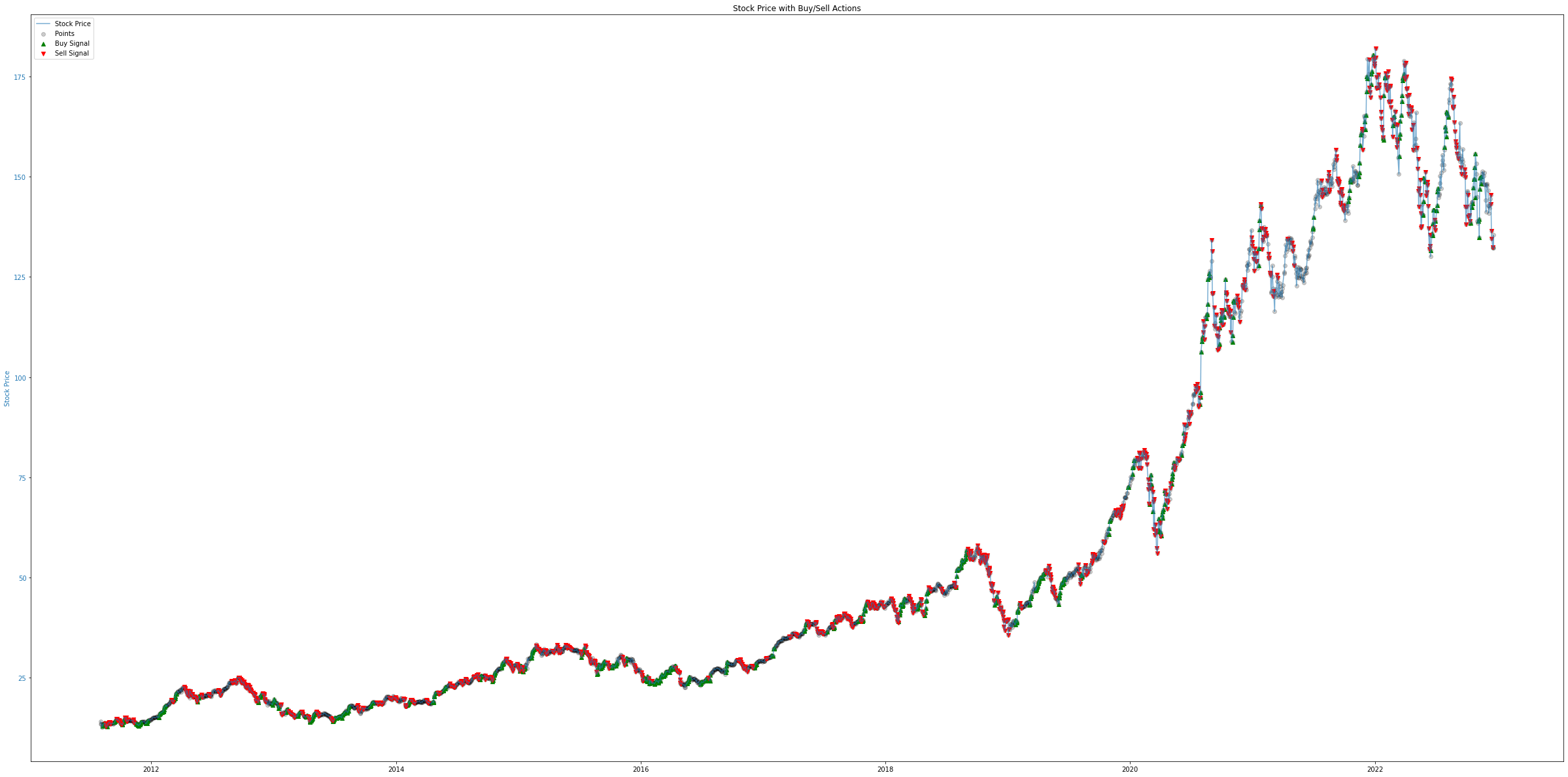
Mean Squared Error (MSE): 4.568191920142539

Mean Absolute Percentage Error (MAPE): 1.87%









Finding the best rolling window

window\_sizes = [5, 10, 20, 40, 80, 160, 320, 640, 1280, 2560]

Processing: 100%|██████████| 3061/3061 [01:34<00:00, 32.39it/s]

Mean Squared Error (MSE): 3.458906869890099

Mean Absolute Percentage Error (MAPE): 1.64%

Root Mean Squared Error (RMSE): 1.8598136653681463

Processing: 100%|██████████| 3056/3056 [01:36<00:00, 31.70it/s]

Mean Squared Error (MSE): 4.139131158662535

Mean Absolute Percentage Error (MAPE): 1.77%

Root Mean Squared Error (RMSE): 2.0344854776238965

Processing: 100%|██████████| 3046/3046 [01:44<00:00, 29.11it/s]

Mean Squared Error (MSE): 3.8624051315141092

Mean Absolute Percentage Error (MAPE): 1.76%

Root Mean Squared Error (RMSE): 1.9653002649758406

Processing: 100%|██████████| 3026/3026 [01:58<00:00, 25.48it/s]

Mean Squared Error (MSE): 3.9433788198004485

Mean Absolute Percentage Error (MAPE): 1.72%

Root Mean Squared Error (RMSE): 1.9857942541462972

Processing: 100%|██████████| 2986/2986 [02:03<00:00, 24.16it/s]

Mean Squared Error (MSE): 3.8313669424375485

Mean Absolute Percentage Error (MAPE): 1.73%

Root Mean Squared Error (RMSE): 1.9573877854011321

Processing: 100%|██████████| 2906/2906 [02:31<00:00, 19.24it/s]

Mean Squared Error (MSE): 4.503407679129165

Mean Absolute Percentage Error (MAPE): 1.88%

Root Mean Squared Error (RMSE): 2.122123389232861

Processing: 100%|██████████| 2746/2746 [03:28<00:00, 13.16it/s]

Mean Squared Error (MSE): 5.0816745281772855

Mean Absolute Percentage Error (MAPE): 1.98%

Root Mean Squared Error (RMSE): 2.2542569791790124

Processing: 100%|██████████| 2426/2426 [04:28<00:00, 9.04it/s]

Mean Squared Error (MSE): 5.6436716158188105

Mean Absolute Percentage Error (MAPE): 1.99%

Root Mean Squared Error (RMSE): 2.37564130622003

Processing: 100%|██████████| 1786/1786 [05:11<00:00, 5.74it/s]

Mean Squared Error (MSE): 7.200468082765067

Mean Absolute Percentage Error (MAPE): 2.04%

Root Mean Squared Error (RMSE): 2.6833687936556663

Processing: 100%|██████████| 506/506 [02:29<00:00, 3.38it/s]

Mean Squared Error (MSE): 18.30975751733691

Mean Absolute Percentage Error (MAPE): 2.23%

Root Mean Squared Error (RMSE): 4.278990245062134

With windows of 5 TSLA

Processing: 100%|██████████| 2939/2939 [01:27<00:00, 33.45it/s]

Mean Squared Error (MSE): 32.22608128946541

Mean Absolute Percentage Error (MAPE): 3.16%

Root Mean Squared Error (RMSE): 5.676802030145618

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AAPL

Processing: 100%|██████████| 3061/3061 [01:31<00:00, 33.35it/s]

Mean Squared Error (MSE): 3.458906869890099

Mean Absolute Percentage Error (MAPE): 1.64%

Root Mean Squared Error (RMSE): 1.8598136653681463

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MSFT

Processing: 100%|██████████| 3061/3061 [01:32<00:00, 33.26it/s]

Mean Squared Error (MSE): 11.11895563102922

Mean Absolute Percentage Error (MAPE): 1.46%

Root Mean Squared Error (RMSE): 3.3345098037086682

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AMZN

Processing: 100%|██████████| 3061/3061 [01:31<00:00, 33.41it/s]

Mean Squared Error (MSE): 5.597891600063091

Mean Absolute Percentage Error (MAPE): 1.87%

Root Mean Squared Error (RMSE): 2.3659863905067358

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GOOG

Processing: 100%|██████████| 3061/3061 [01:31<00:00, 33.42it/s]

Mean Squared Error (MSE): 2.3202525681606776

Mean Absolute Percentage Error (MAPE): 1.51%

Root Mean Squared Error (RMSE): 1.5232375284769863

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Tunning

[I 2023-11-26 22:41:16,018] A new study created in memory with name: no-name-6d2eff44-a122-4b88-b8ff-3bb9145c310e

Processing: 100%|██████████| 1986/1986 [02:00<00:00, 16.45it/s]

[I 2023-11-26 22:43:16,724] Trial 0 finished with value: 2.0666417317164365 and parameters: {'n\_estimators': 295, 'max\_depth': 3, 'min\_child\_weight': 4, 'gamma': 0.5705896984374621, 'learning\_rate': 0.07918942288954987, 'subsample': 0.8363809617476752, 'colsample\_bytree': 0.9289926962933633, 'reg\_alpha': 0.4985405612929691, 'reg\_lambda': 0.12316812748477574}. Best is trial 0 with value: 2.0666417317164365.

Mean Squared Error (MSE): 7.3498

Mean Absolute Error (MAE): 2.0666

Processing: 100%|██████████| 1986/1986 [02:13<00:00, 14.89it/s]

[I 2023-11-26 22:45:30,097] Trial 1 finished with value: 2.688981798546783 and parameters: {'n\_estimators': 356, 'max\_depth': 4, 'min\_child\_weight': 6, 'gamma': 0.5991006792371154, 'learning\_rate': 0.07612994523101423, 'subsample': 0.8961553888218652, 'colsample\_bytree': 0.9112584340770313, 'reg\_alpha': 0.0527380555721165, 'reg\_lambda': 0.0003175741449990075}. Best is trial 0 with value: 2.0666417317164365.

Mean Squared Error (MSE): 12.1970

Mean Absolute Error (MAE): 2.6890

Processing: 100%|██████████| 1986/1986 [01:42<00:00, 19.47it/s]

[I 2023-11-26 22:47:12,130] Trial 2 finished with value: 1.8943743451863535 and parameters: {'n\_estimators': 239, 'max\_depth': 7, 'min\_child\_weight': 4, 'gamma': 0.2060573433377163, 'learning\_rate': 0.06267458555050395, 'subsample': 0.6746826986213214, 'colsample\_bytree': 0.9270395813879955, 'reg\_alpha': 0.0077293323190843035, 'reg\_lambda': 0.2884903860835927}. Best is trial 2 with value: 1.8943743451863535.

Mean Squared Error (MSE): 6.4900

Mean Absolute Error (MAE): 1.8944

Processing: 100%|██████████| 1986/1986 [02:44<00:00, 12.06it/s]

[I 2023-11-26 22:49:56,813] Trial 3 finished with value: 2.231622723839136 and parameters: {'n\_estimators': 458, 'max\_depth': 6, 'min\_child\_weight': 5, 'gamma': 0.40872011288486043, 'learning\_rate': 0.06275834652492064, 'subsample': 0.7068361031811492, 'colsample\_bytree': 0.7504916804651208, 'reg\_alpha': 0.0023407103414743438, 'reg\_lambda': 0.0002829924657414409}. Best is trial 2 with value: 1.8943743451863535.

Mean Squared Error (MSE): 8.6868

Mean Absolute Error (MAE): 2.2316

Processing: 100%|██████████| 1986/1986 [01:57<00:00, 16.83it/s]

[I 2023-11-26 22:51:54,805] Trial 4 finished with value: 1.859173815951041 and parameters: {'n\_estimators': 289, 'max\_depth': 5, 'min\_child\_weight': 4, 'gamma': 0.24559455338069125, 'learning\_rate': 0.05259642503475027, 'subsample': 0.9876239128842066, 'colsample\_bytree': 0.8079522247120787, 'reg\_alpha': 7.548355799728353e-05, 'reg\_lambda': 0.07120909835428513}. Best is trial 4 with value: 1.859173815951041.

Mean Squared Error (MSE): 6.1950

Mean Absolute Error (MAE): 1.8592

Processing: 100%|██████████| 1986/1986 [01:33<00:00, 21.28it/s]

[I 2023-11-26 22:53:28,134] Trial 5 finished with value: 1.976797110209724 and parameters: {'n\_estimators': 201, 'max\_depth': 5, 'min\_child\_weight': 1, 'gamma': 0.6684989456265624, 'learning\_rate': 0.02905662037136983, 'subsample': 0.6899991665708066, 'colsample\_bytree': 0.9691394120830498, 'reg\_alpha': 0.004171004294836419, 'reg\_lambda': 0.0004909904658922275}. Best is trial 4 with value: 1.859173815951041.

Mean Squared Error (MSE): 7.0600

Mean Absolute Error (MAE): 1.9768

Processing: 100%|██████████| 1986/1986 [02:49<00:00, 11.69it/s]

[I 2023-11-26 22:56:18,071] Trial 6 finished with value: 2.0733324261965556 and parameters: {'n\_estimators': 461, 'max\_depth': 5, 'min\_child\_weight': 1, 'gamma': 0.7969431229983331, 'learning\_rate': 0.03830808149307586, 'subsample': 0.7059016561995132, 'colsample\_bytree': 0.6130521168520741, 'reg\_alpha': 0.7712851988502958, 'reg\_lambda': 0.10459901001890429}. Best is trial 4 with value: 1.859173815951041.

Mean Squared Error (MSE): 7.1476

Mean Absolute Error (MAE): 2.0733

Processing: 100%|██████████| 1986/1986 [02:02<00:00, 16.15it/s]

[I 2023-11-26 22:58:21,071] Trial 7 finished with value: 1.923890767632227 and parameters: {'n\_estimators': 307, 'max\_depth': 4, 'min\_child\_weight': 2, 'gamma': 0.662377230982767, 'learning\_rate': 0.08403213586728894, 'subsample': 0.7930429896039372, 'colsample\_bytree': 0.6703057199882058, 'reg\_alpha': 1.2194731110092569e-05, 'reg\_lambda': 0.8905797943021542}. Best is trial 4 with value: 1.859173815951041.

Mean Squared Error (MSE): 6.3734

Mean Absolute Error (MAE): 1.9239

Processing: 100%|██████████| 1986/1986 [01:48<00:00, 18.27it/s]

[I 2023-11-26 23:00:09,798] Trial 8 finished with value: 1.9337254642684218 and parameters: {'n\_estimators': 247, 'max\_depth': 5, 'min\_child\_weight': 4, 'gamma': 0.578365062476646, 'learning\_rate': 0.08789828140868211, 'subsample': 0.6577795791796995, 'colsample\_bytree': 0.7730546587780086, 'reg\_alpha': 0.0021238766128353352, 'reg\_lambda': 4.996616026770486e-05}. Best is trial 4 with value: 1.859173815951041.

Mean Squared Error (MSE): 6.5323

Mean Absolute Error (MAE): 1.9337

Processing: 100%|██████████| 1986/1986 [02:23<00:00, 13.86it/s]

[I 2023-11-26 23:02:33,072] Trial 9 finished with value: 1.934388423791307 and parameters: {'n\_estimators': 384, 'max\_depth': 3, 'min\_child\_weight': 4, 'gamma': 0.6004550417901382, 'learning\_rate': 0.07938648191032721, 'subsample': 0.9893698865570194, 'colsample\_bytree': 0.8306759912962028, 'reg\_alpha': 6.456306164509282e-05, 'reg\_lambda': 0.11580017357474275}. Best is trial 4 with value: 1.859173815951041.

Mean Squared Error (MSE): 6.5503

Mean Absolute Error (MAE): 1.9344

Processing: 100%|██████████| 1986/1986 [00:55<00:00, 35.88it/s]

[I 2023-11-26 23:03:28,451] Trial 10 finished with value: 2.6582654856712518 and parameters: {'n\_estimators': 103, 'max\_depth': 7, 'min\_child\_weight': 6, 'gamma': 0.1741430124799995, 'learning\_rate': 0.012224780157941421, 'subsample': 0.9873505709195516, 'colsample\_bytree': 0.839996599230277, 'reg\_alpha': 0.0001456373068522447, 'reg\_lambda': 0.015879502100255717}. Best is trial 4 with value: 1.859173815951041.

Mean Squared Error (MSE): 11.9552

Mean Absolute Error (MAE): 2.6583

Processing: 100%|██████████| 1986/1986 [01:24<00:00, 23.52it/s]

[I 2023-11-26 23:04:52,922] Trial 11 finished with value: 1.8354995231697189 and parameters: {'n\_estimators': 182, 'max\_depth': 7, 'min\_child\_weight': 3, 'gamma': 0.1092361721024932, 'learning\_rate': 0.05357960388595802, 'subsample': 0.7691943569713451, 'colsample\_bytree': 0.9957144616126654, 'reg\_alpha': 0.00042102675386253497, 'reg\_lambda': 0.006888730351597488}. Best is trial 11 with value: 1.8354995231697189.

Mean Squared Error (MSE): 6.1576

Mean Absolute Error (MAE): 1.8355

Processing: 100%|██████████| 1986/1986 [01:13<00:00, 27.15it/s]

[I 2023-11-26 23:06:06,133] Trial 12 finished with value: 1.8457540257641585 and parameters: {'n\_estimators': 144, 'max\_depth': 6, 'min\_child\_weight': 3, 'gamma': 0.10696038069741803, 'learning\_rate': 0.05098773678848299, 'subsample': 0.7873170882384284, 'colsample\_bytree': 0.9736853304601205, 'reg\_alpha': 0.00023339131321952156, 'reg\_lambda': 0.010462684629830247}. Best is trial 11 with value: 1.8354995231697189.

Mean Squared Error (MSE): 6.2312

Mean Absolute Error (MAE): 1.8458

Processing: 100%|██████████| 1986/1986 [01:06<00:00, 30.04it/s]

[I 2023-11-26 23:07:12,275] Trial 13 finished with value: 1.854077170281047 and parameters: {'n\_estimators': 128, 'max\_depth': 6, 'min\_child\_weight': 2, 'gamma': 0.13856167911287587, 'learning\_rate': 0.09987584266111878, 'subsample': 0.7672697245603607, 'colsample\_bytree': 0.9731894934180223, 'reg\_alpha': 0.0003730951781108642, 'reg\_lambda': 0.007826325326823645}. Best is trial 11 with value: 1.8354995231697189.

Mean Squared Error (MSE): 6.4879

Mean Absolute Error (MAE): 1.8541

Processing: 100%|██████████| 1986/1986 [01:20<00:00, 24.66it/s]

[I 2023-11-26 23:08:32,835] Trial 14 finished with value: 1.9278619726942534 and parameters: {'n\_estimators': 172, 'max\_depth': 6, 'min\_child\_weight': 3, 'gamma': 0.33316933235806523, 'learning\_rate': 0.048220624425754775, 'subsample': 0.7568159573755238, 'colsample\_bytree': 0.998281703554416, 'reg\_alpha': 0.0004899158611615407, 'reg\_lambda': 0.0048751369825957265}. Best is trial 11 with value: 1.8354995231697189.

Mean Squared Error (MSE): 6.6485

Mean Absolute Error (MAE): 1.9279

Processing: 100%|██████████| 1986/1986 [01:19<00:00, 25.11it/s]

[I 2023-11-26 23:09:51,951] Trial 15 finished with value: 1.834338275737033 and parameters: {'n\_estimators': 165, 'max\_depth': 7, 'min\_child\_weight': 3, 'gamma': 0.1003426448748358, 'learning\_rate': 0.06326201902514565, 'subsample': 0.602860296533392, 'colsample\_bytree': 0.8931873807664221, 'reg\_alpha': 0.0006425418503506678, 'reg\_lambda': 0.0018916659565747472}. Best is trial 15 with value: 1.834338275737033.

Mean Squared Error (MSE): 6.1269

Mean Absolute Error (MAE): 1.8343

Processing: 100%|██████████| 1986/1986 [01:29<00:00, 22.17it/s]

[I 2023-11-26 23:11:21,549] Trial 16 finished with value: 1.9056644870156405 and parameters: {'n\_estimators': 205, 'max\_depth': 7, 'min\_child\_weight': 2, 'gamma': 0.376988792933582, 'learning\_rate': 0.0656612843953324, 'subsample': 0.6038059642369731, 'colsample\_bytree': 0.8802705137335616, 'reg\_alpha': 0.0007059160019323237, 'reg\_lambda': 0.001583419303627436}. Best is trial 15 with value: 1.834338275737033.

Mean Squared Error (MSE): 6.5530

Mean Absolute Error (MAE): 1.9057

Processing: 100%|██████████| 1986/1986 [01:18<00:00, 25.19it/s]

[I 2023-11-26 23:12:40,415] Trial 17 finished with value: 1.936120039027684 and parameters: {'n\_estimators': 165, 'max\_depth': 7, 'min\_child\_weight': 3, 'gamma': 0.28333080964342383, 'learning\_rate': 0.039928345960208826, 'subsample': 0.6107009594680758, 'colsample\_bytree': 0.872331788788565, 'reg\_alpha': 0.01637901783712454, 'reg\_lambda': 0.0019113374249864446}. Best is trial 15 with value: 1.834338275737033.

Mean Squared Error (MSE): 6.6582

Mean Absolute Error (MAE): 1.9361

Processing: 100%|██████████| 1986/1986 [00:54<00:00, 36.39it/s]

[I 2023-11-26 23:13:35,025] Trial 18 finished with value: 2.8425279659941496 and parameters: {'n\_estimators': 100, 'max\_depth': 7, 'min\_child\_weight': 5, 'gamma': 0.10554710903345507, 'learning\_rate': 0.0652012988541424, 'subsample': 0.6391530974605465, 'colsample\_bytree': 0.9283940686136607, 'reg\_alpha': 0.0009269896628837087, 'reg\_lambda': 0.025201448607979838}. Best is trial 15 with value: 1.834338275737033.

Mean Squared Error (MSE): 13.5135

Mean Absolute Error (MAE): 2.8425

Processing: 100%|██████████| 1986/1986 [01:38<00:00, 20.13it/s]

[I 2023-11-26 23:15:13,733] Trial 19 finished with value: 1.9271768158449087 and parameters: {'n\_estimators': 237, 'max\_depth': 6, 'min\_child\_weight': 2, 'gamma': 0.44305855270368183, 'learning\_rate': 0.0689630828561566, 'subsample': 0.7304104802240774, 'colsample\_bytree': 0.9996733330084899, 'reg\_alpha': 4.109613710319519e-05, 'reg\_lambda': 0.0025355996253956944}. Best is trial 15 with value: 1.834338275737033.

Mean Squared Error (MSE): 6.7935

Mean Absolute Error (MAE): 1.9272

Processing: 100%|██████████| 1986/1986 [01:25<00:00, 23.33it/s]

[I 2023-11-26 23:16:38,898] Trial 20 finished with value: 1.9027795156859921 and parameters: {'n\_estimators': 189, 'max\_depth': 7, 'min\_child\_weight': 3, 'gamma': 0.3084524234829352, 'learning\_rate': 0.057918024200738896, 'subsample': 0.6313715904918727, 'colsample\_bytree': 0.8776683535593219, 'reg\_alpha': 0.0014022617486257817, 'reg\_lambda': 1.4970428942099607e-05}. Best is trial 15 with value: 1.834338275737033.

Mean Squared Error (MSE): 6.4362

Mean Absolute Error (MAE): 1.9028

Processing: 100%|██████████| 1986/1986 [01:13<00:00, 27.06it/s]

[I 2023-11-26 23:17:52,341] Trial 21 finished with value: 1.8295899386749876 and parameters: {'n\_estimators': 144, 'max\_depth': 6, 'min\_child\_weight': 3, 'gamma': 0.1100439555268986, 'learning\_rate': 0.049115528010421274, 'subsample': 0.8198097222123593, 'colsample\_bytree': 0.9621878520210566, 'reg\_alpha': 0.0002445015581319581, 'reg\_lambda': 0.013302813965945692}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.1594

Mean Absolute Error (MAE): 1.8296

Processing: 100%|██████████| 1986/1986 [01:11<00:00, 27.69it/s]

[I 2023-11-26 23:19:04,109] Trial 22 finished with value: 1.8598859740967546 and parameters: {'n\_estimators': 142, 'max\_depth': 6, 'min\_child\_weight': 3, 'gamma': 0.21103721919397928, 'learning\_rate': 0.05465867371317609, 'subsample': 0.826449606882653, 'colsample\_bytree': 0.9519891775297449, 'reg\_alpha': 0.00024009602875612715, 'reg\_lambda': 0.03183385913124153}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.2475

Mean Absolute Error (MAE): 1.8599

Processing: 100%|██████████| 1986/1986 [01:36<00:00, 20.52it/s]

[I 2023-11-26 23:20:40,914] Trial 23 finished with value: 1.8691886909819948 and parameters: {'n\_estimators': 222, 'max\_depth': 7, 'min\_child\_weight': 2, 'gamma': 0.1930493866637642, 'learning\_rate': 0.044324986195407326, 'subsample': 0.7269564520562674, 'colsample\_bytree': 0.954662891361287, 'reg\_alpha': 0.0008091511810716619, 'reg\_lambda': 0.005306390505491377}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.5102

Mean Absolute Error (MAE): 1.8692

Processing: 100%|██████████| 1986/1986 [01:47<00:00, 18.49it/s]

[I 2023-11-26 23:22:28,389] Trial 24 finished with value: 2.5169571897242813 and parameters: {'n\_estimators': 267, 'max\_depth': 6, 'min\_child\_weight': 5, 'gamma': 0.11087702214868027, 'learning\_rate': 0.05735421664186274, 'subsample': 0.6605533740622176, 'colsample\_bytree': 0.9037822486354183, 'reg\_alpha': 0.0001374281970354047, 'reg\_lambda': 0.014926812991307246}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 10.8498

Mean Absolute Error (MAE): 2.5170

Processing: 100%|██████████| 1986/1986 [01:21<00:00, 24.41it/s]

[I 2023-11-26 23:23:49,781] Trial 25 finished with value: 1.86657979069139 and parameters: {'n\_estimators': 161, 'max\_depth': 7, 'min\_child\_weight': 3, 'gamma': 0.26953756274655305, 'learning\_rate': 0.07127666720542966, 'subsample': 0.8426572527263635, 'colsample\_bytree': 0.999927801672591, 'reg\_alpha': 0.0004239622205407275, 'reg\_lambda': 0.003575984933052963}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.2726

Mean Absolute Error (MAE): 1.8666

Processing: 100%|██████████| 1986/1986 [01:17<00:00, 25.63it/s]

[I 2023-11-26 23:25:07,302] Trial 26 finished with value: 1.8702481768472539 and parameters: {'n\_estimators': 122, 'max\_depth': 6, 'min\_child\_weight': 2, 'gamma': 0.17156739609464552, 'learning\_rate': 0.04525180557657427, 'subsample': 0.7419720585128682, 'colsample\_bytree': 0.9447461670587831, 'reg\_alpha': 2.730154577576834e-05, 'reg\_lambda': 0.000858965472884221}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.5526

Mean Absolute Error (MAE): 1.8702

Processing: 100%|██████████| 1986/1986 [02:25<00:00, 13.68it/s]

[I 2023-11-26 23:27:32,472] Trial 27 finished with value: 1.8509285592378542 and parameters: {'n\_estimators': 348, 'max\_depth': 7, 'min\_child\_weight': 3, 'gamma': 0.23488649479454082, 'learning\_rate': 0.05851372872572223, 'subsample': 0.6923627130352235, 'colsample\_bytree': 0.8939633820215424, 'reg\_alpha': 0.00013934182935738582, 'reg\_lambda': 0.03406181471959228}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.1318

Mean Absolute Error (MAE): 1.8509

Processing: 100%|██████████| 1986/1986 [01:28<00:00, 22.45it/s]

[I 2023-11-26 23:29:00,953] Trial 28 finished with value: 1.934844470655139 and parameters: {'n\_estimators': 165, 'max\_depth': 7, 'min\_child\_weight': 1, 'gamma': 0.472724220661011, 'learning\_rate': 0.03503480363817093, 'subsample': 0.7736351622121725, 'colsample\_bytree': 0.9333017650451233, 'reg\_alpha': 0.0016336460764094793, 'reg\_lambda': 0.008554115194358513}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.8633

Mean Absolute Error (MAE): 1.9348

Processing: 100%|██████████| 1986/1986 [01:40<00:00, 19.78it/s]

[I 2023-11-26 23:30:41,397] Trial 29 finished with value: 1.904834077932692 and parameters: {'n\_estimators': 206, 'max\_depth': 6, 'min\_child\_weight': 4, 'gamma': 0.33802660116223937, 'learning\_rate': 0.07189428300926368, 'subsample': 0.8245971130583785, 'colsample\_bytree': 0.9170123813078741, 'reg\_alpha': 0.0003376080705502078, 'reg\_lambda': 0.0033141422383683025}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.4858

Mean Absolute Error (MAE): 1.9048

Processing: 100%|██████████| 1986/1986 [01:29<00:00, 22.27it/s]

[I 2023-11-26 23:32:10,619] Trial 30 finished with value: 2.0982722027619056 and parameters: {'n\_estimators': 182, 'max\_depth': 5, 'min\_child\_weight': 5, 'gamma': 0.15546660844004517, 'learning\_rate': 0.04842321503385489, 'subsample': 0.8506695091295096, 'colsample\_bytree': 0.9629819746025151, 'reg\_alpha': 0.000997802921516206, 'reg\_lambda': 0.0011065028148995195}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 7.9095

Mean Absolute Error (MAE): 2.0983

Processing: 100%|██████████| 1986/1986 [01:18<00:00, 25.26it/s]

[I 2023-11-26 23:33:29,288] Trial 31 finished with value: 1.8486824370201733 and parameters: {'n\_estimators': 142, 'max\_depth': 6, 'min\_child\_weight': 3, 'gamma': 0.10371105831837682, 'learning\_rate': 0.05069863348783568, 'subsample': 0.7919727218849804, 'colsample\_bytree': 0.9709567707916117, 'reg\_alpha': 0.00018333471189717218, 'reg\_lambda': 0.008852068513089447}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.2545

Mean Absolute Error (MAE): 1.8487

Processing: 100%|██████████| 1986/1986 [01:19<00:00, 24.96it/s]

[I 2023-11-26 23:34:48,890] Trial 32 finished with value: 1.838274965911453 and parameters: {'n\_estimators': 141, 'max\_depth': 4, 'min\_child\_weight': 3, 'gamma': 0.1542689140121063, 'learning\_rate': 0.05363618485877153, 'subsample': 0.8805198328695291, 'colsample\_bytree': 0.9775792120167771, 'reg\_alpha': 0.00025286793310988145, 'reg\_lambda': 0.015666103479593785}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.2051

Mean Absolute Error (MAE): 1.8383

Processing: 100%|██████████| 1986/1986 [01:07<00:00, 29.35it/s]

[I 2023-11-26 23:35:56,590] Trial 33 finished with value: 1.8485555922717962 and parameters: {'n\_estimators': 120, 'max\_depth': 4, 'min\_child\_weight': 3, 'gamma': 0.22723699129644576, 'learning\_rate': 0.05877874492746505, 'subsample': 0.8846439646967795, 'colsample\_bytree': 0.9355467304925587, 'reg\_alpha': 8.26048634946764e-05, 'reg\_lambda': 0.02343235357208242}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.1759

Mean Absolute Error (MAE): 1.8486

Processing: 100%|██████████| 1986/1986 [02:48<00:00, 11.79it/s]

[I 2023-11-26 23:38:45,084] Trial 34 finished with value: 1.8563742215596024 and parameters: {'n\_estimators': 417, 'max\_depth': 3, 'min\_child\_weight': 4, 'gamma': 0.19918145343548327, 'learning\_rate': 0.06379141821449792, 'subsample': 0.873811611876007, 'colsample\_bytree': 0.9138044763628651, 'reg\_alpha': 0.0005661370772072779, 'reg\_lambda': 0.060059677067410874}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.2390

Mean Absolute Error (MAE): 1.8564

Processing: 100%|██████████| 1986/1986 [02:07<00:00, 15.54it/s]

[I 2023-11-26 23:40:52,888] Trial 35 finished with value: 1.8686561084364648 and parameters: {'n\_estimators': 264, 'max\_depth': 4, 'min\_child\_weight': 2, 'gamma': 0.1536684143682721, 'learning\_rate': 0.05297864146477644, 'subsample': 0.9126839663119343, 'colsample\_bytree': 0.9794000129277822, 'reg\_alpha': 0.0036741803300120003, 'reg\_lambda': 0.005448684935259358}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.8068

Mean Absolute Error (MAE): 1.8687

Processing: 100%|██████████| 1986/1986 [01:49<00:00, 18.12it/s]

[I 2023-11-26 23:42:42,533] Trial 36 finished with value: 1.8982097397783597 and parameters: {'n\_estimators': 219, 'max\_depth': 3, 'min\_child\_weight': 4, 'gamma': 0.267233171216374, 'learning\_rate': 0.05964924197404908, 'subsample': 0.8057643834546627, 'colsample\_bytree': 0.9480659309503656, 'reg\_alpha': 0.006128866310905977, 'reg\_lambda': 0.05207188067369735}. Best is trial 21 with value: 1.8295899386749876.

Mean Squared Error (MSE): 6.4869

Mean Absolute Error (MAE): 1.8982

Processing: 100%|██████████| 1986/1986 [02:36<00:00, 12.71it/s]

[I 2023-11-26 23:45:18,881] Trial 37 finished with value: 1.829307442978721 and parameters: {'n\_estimators': 309, 'max\_depth': 5, 'min\_child\_weight': 3, 'gamma': 0.15186097003049082, 'learning\_rate': 0.05374239491599335, 'subsample': 0.7113104114026579, 'colsample\_bytree': 0.9251376238321264, 'reg\_alpha': 0.0021887652757847653, 'reg\_lambda': 0.014582652001637117}. Best is trial 37 with value: 1.829307442978721.

Mean Squared Error (MSE): 6.0665

Mean Absolute Error (MAE): 1.8293

Processing: 100%|██████████| 1986/1986 [02:26<00:00, 13.52it/s]

[I 2023-11-26 23:47:45,765] Trial 38 finished with value: 1.8670360424339694 and parameters: {'n\_estimators': 320, 'max\_depth': 5, 'min\_child\_weight': 4, 'gamma': 0.23582622112313675, 'learning\_rate': 0.06239404613678916, 'subsample': 0.7145600143383961, 'colsample\_bytree': 0.9054454399176209, 'reg\_alpha': 0.0021079549520845817, 'reg\_lambda': 0.0005419422471624583}. Best is trial 37 with value: 1.829307442978721.

Mean Squared Error (MSE): 6.3082

Mean Absolute Error (MAE): 1.8670

Processing: 100%|██████████| 1986/1986 [02:39<00:00, 12.43it/s]

[I 2023-11-26 23:50:25,555] Trial 39 finished with value: 1.8537090721145992 and parameters: {'n\_estimators': 331, 'max\_depth': 5, 'min\_child\_weight': 2, 'gamma': 0.18480675041303224, 'learning\_rate': 0.041942081151454716, 'subsample': 0.6807065589927475, 'colsample\_bytree': 0.9281004914921238, 'reg\_alpha': 0.014835986964146798, 'reg\_lambda': 0.17421772027007887}. Best is trial 37 with value: 1.829307442978721.

Mean Squared Error (MSE): 6.3316

Mean Absolute Error (MAE): 1.8537