

Zelta Tech's: BTC/USD Trading Model Challenge

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Introduction

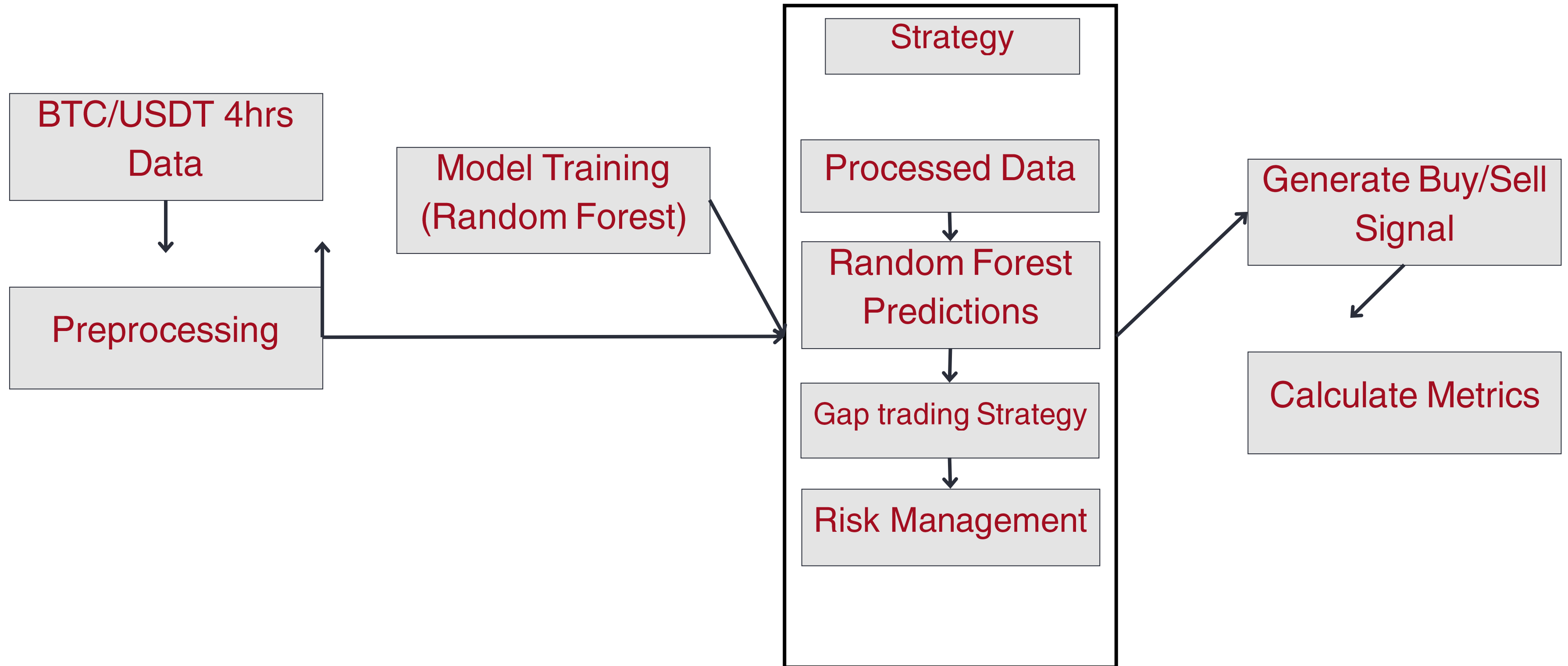
Problem Statement: Algorithmic Trading Model Development for BTC/USDT Crypto Market.

-> Main task is crafting models that outperform benchmarks, balancing returns and risk management in the dynamic BTC/USDT market.

Algorithmic trading, enhanced by the integration of artificial intelligence, embodies a potent synergy, optimizing market strategies with the precision of computational analysis and adaptive learning for more informed and dynamic decision-making.



Our Approach





Dataset

**Historical BTC/USDT 4hrs data
January 1, 2018
to
January 31, 2022**



Preprocessing

Feature Selection

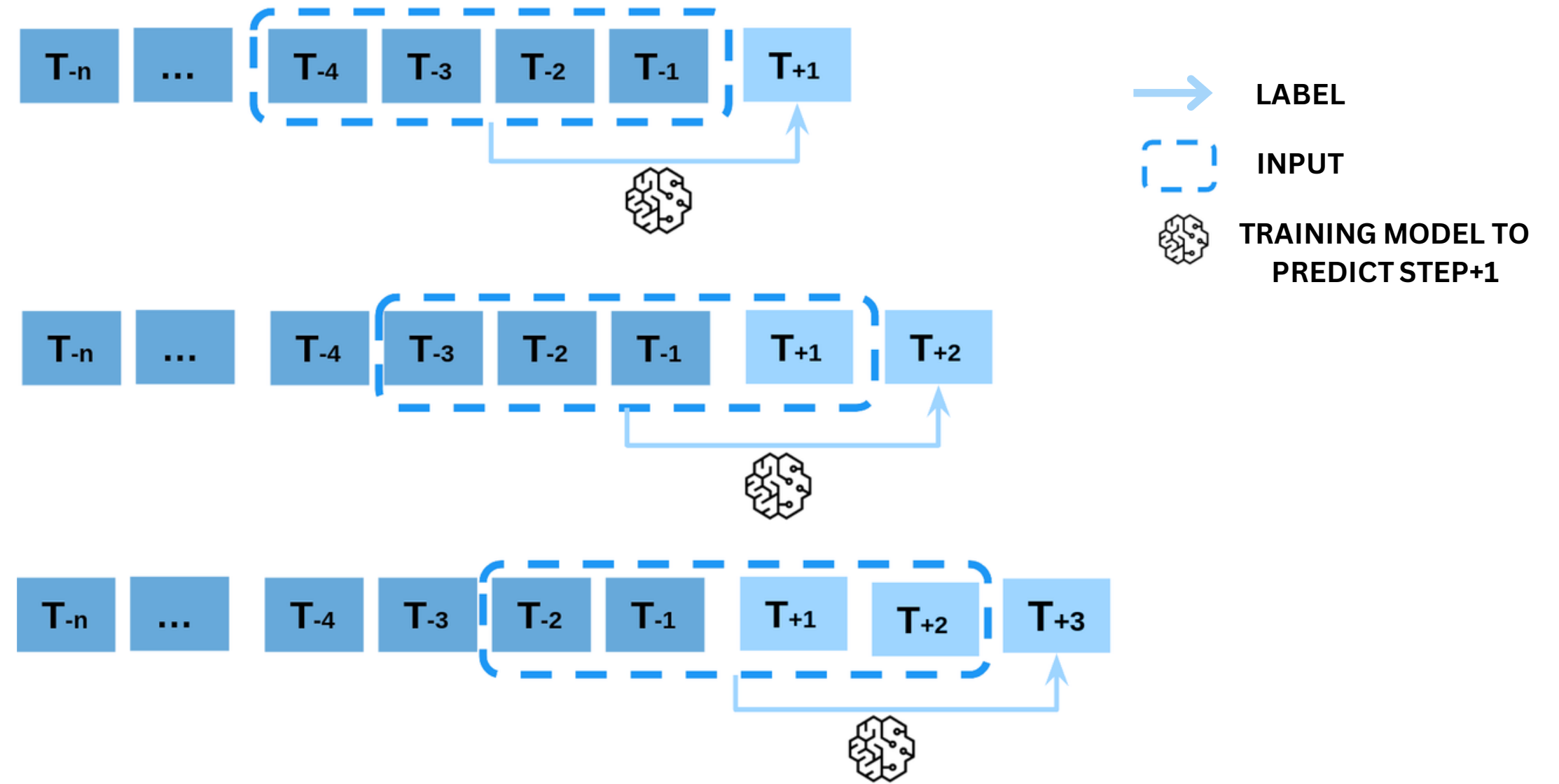
The 'opening price' feature from the BTC/USDT dataset is used in training and testing the machine learning model .

datetime	open	high	low	close	volume
2018-01-01 05:30:00	13715.65	13715.65	13155.38	13410.03	1676.204807
2018-01-01 09:30:00	13434.98	13818.55	13322.15	13570.35	1302.214836
2018-01-01 13:30:00	13569.98	13735.24	13001.13	13220.56	1319.755931
2018-01-01 17:30:00	13220.56	13330.00	12750.00	13247.00	1831.933153
2018-01-01 21:30:00	13247.00	13290.65	12940.00	13240.37	1092.337234
2018-01-02 01:30:00	13222.03	13599.70	13222.03	13380.00	1387.469883
2018-01-02 05:30:00	13382.16	13850.00	13231.96	13353.78	2365.532926
2018-01-02 09:30:00	13353.78	13480.84	12890.02	13343.00	2980.316053
2018-01-02 13:30:00	13343.01	13617.28	13302.59	13490.00	2596.182674
2018-01-02 17:30:00	13490.00	13894.86	13450.46	13690.03	3365.879508

Sequences

Creation:

Considering the last 10 observations and forecasting a single future observation for each sequence.

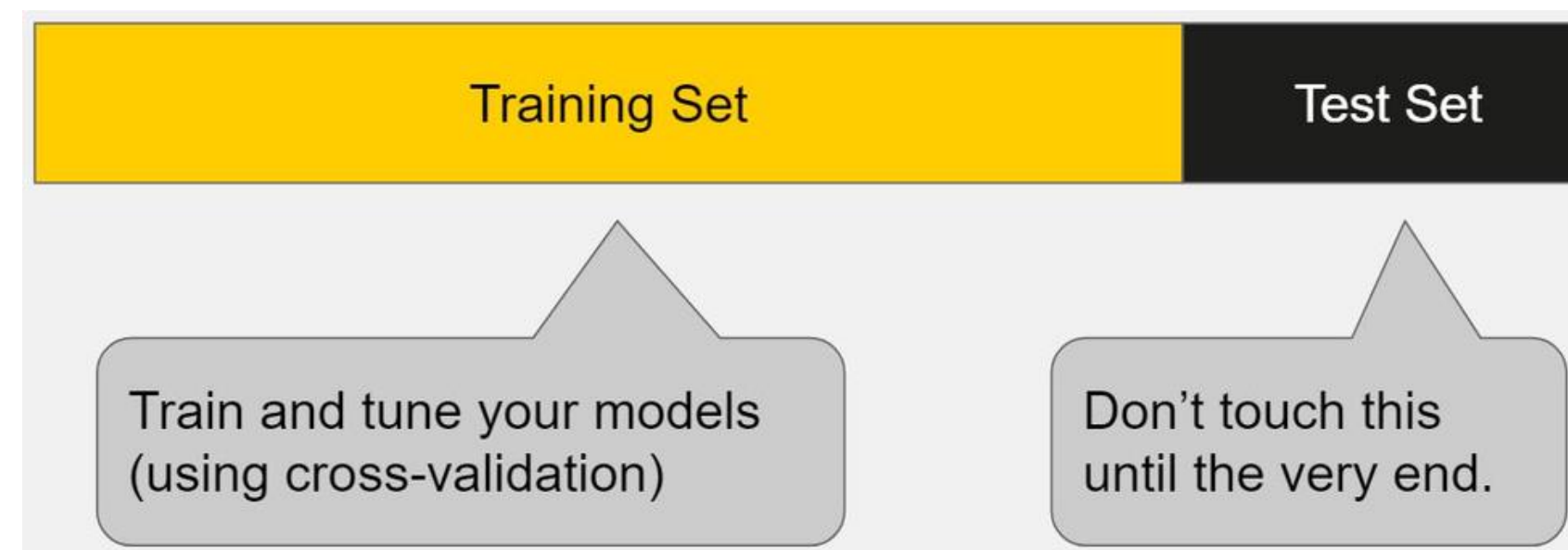


Train-Test Split:

The split ratio is 80% for training and 20% for testing.

Training Data : Jan 2018 - Apr 2021

Testing Data : Apr 2021 - Jan 2022

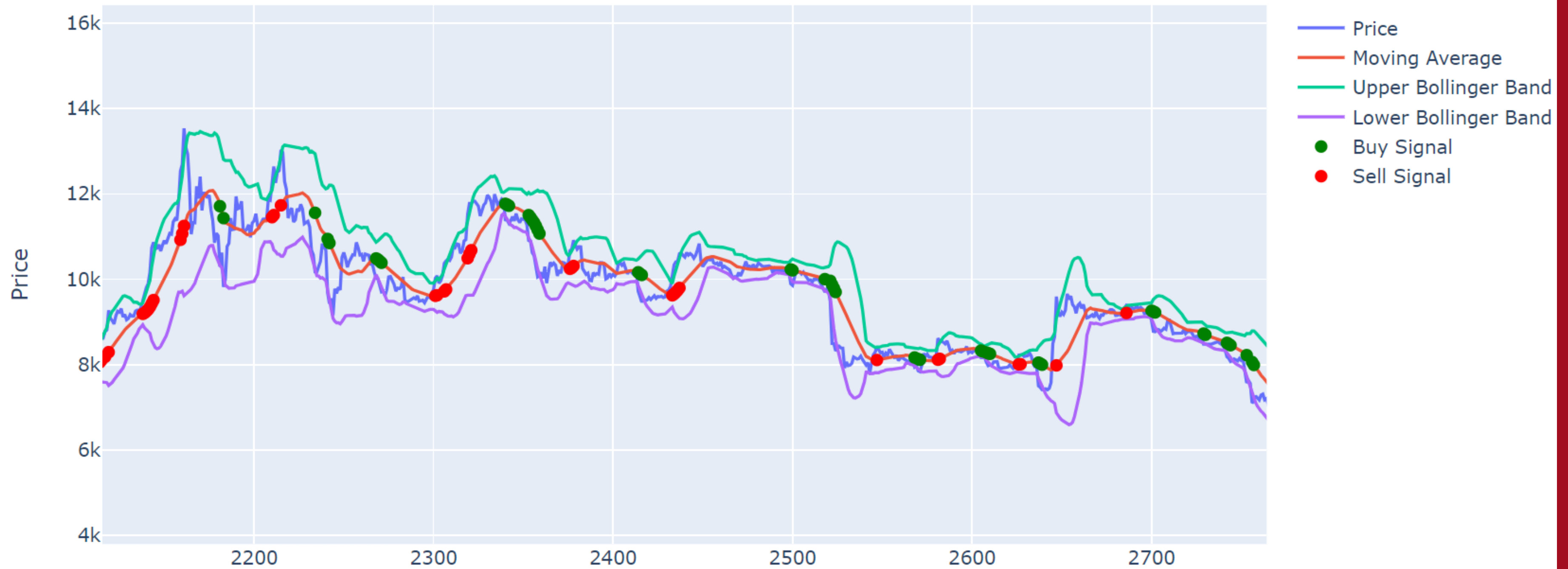


Strategies

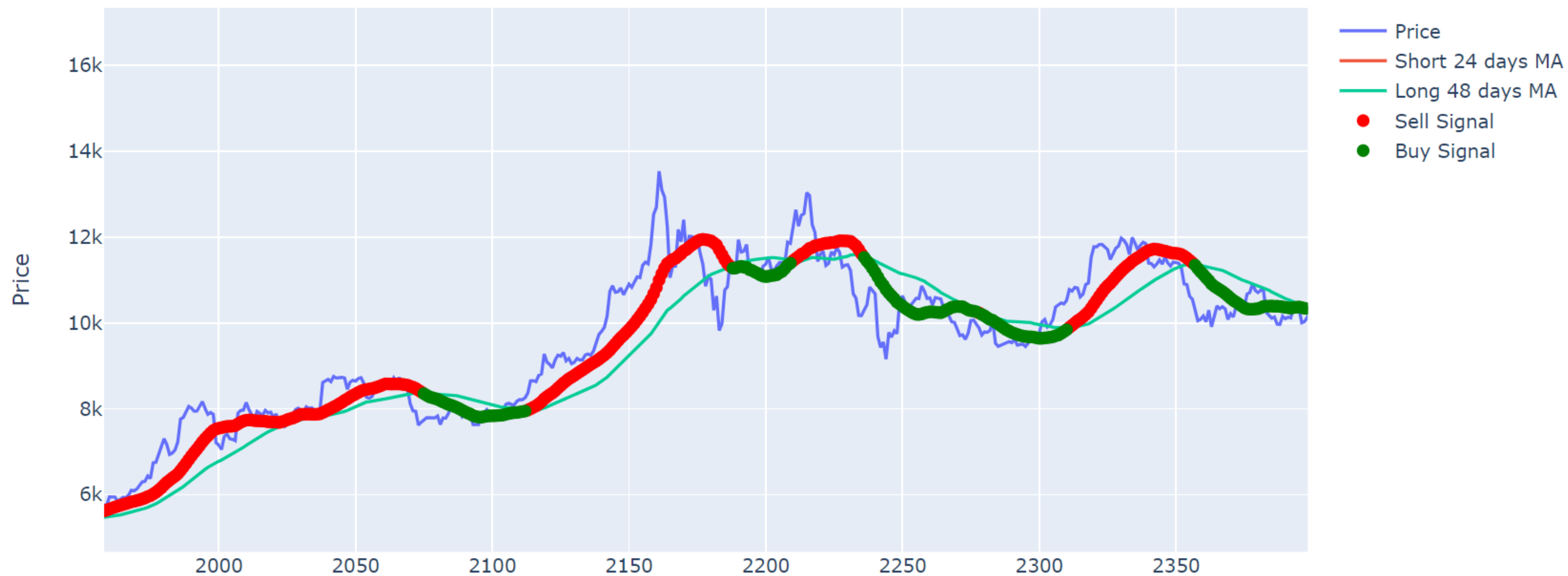
A set of rules that one follows to make decisions about buying or selling

- A myriad of strategies have been developed to analyze market trends and guide decision-making processes like
 - Bollinger Bands
 - Moving Average Cross-over,
 - Rate of Change - Price-to-Earnings Ratio Strategy (ROC-PE),
 - RSI,
 - Demarker Strategy,
 - Stochastic Oscillator,
 - MACD, etc.

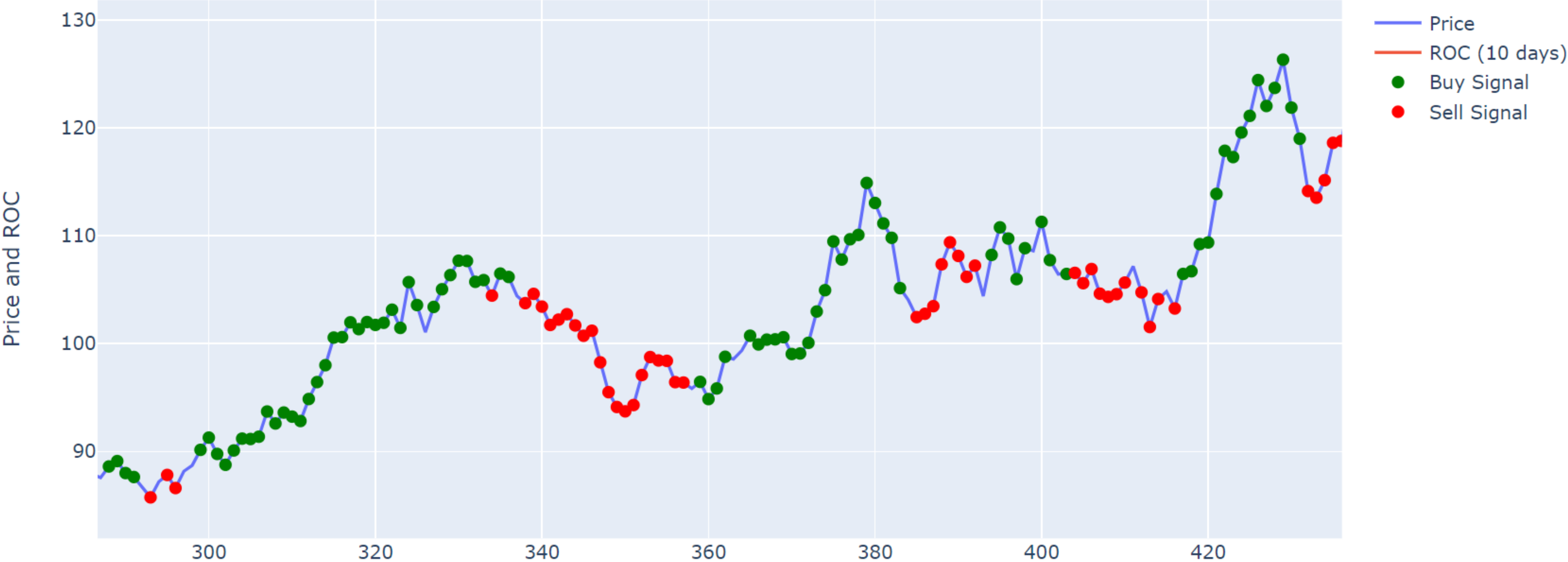
Bollinger Bands Strategy



Moving Average Crossover Strategy

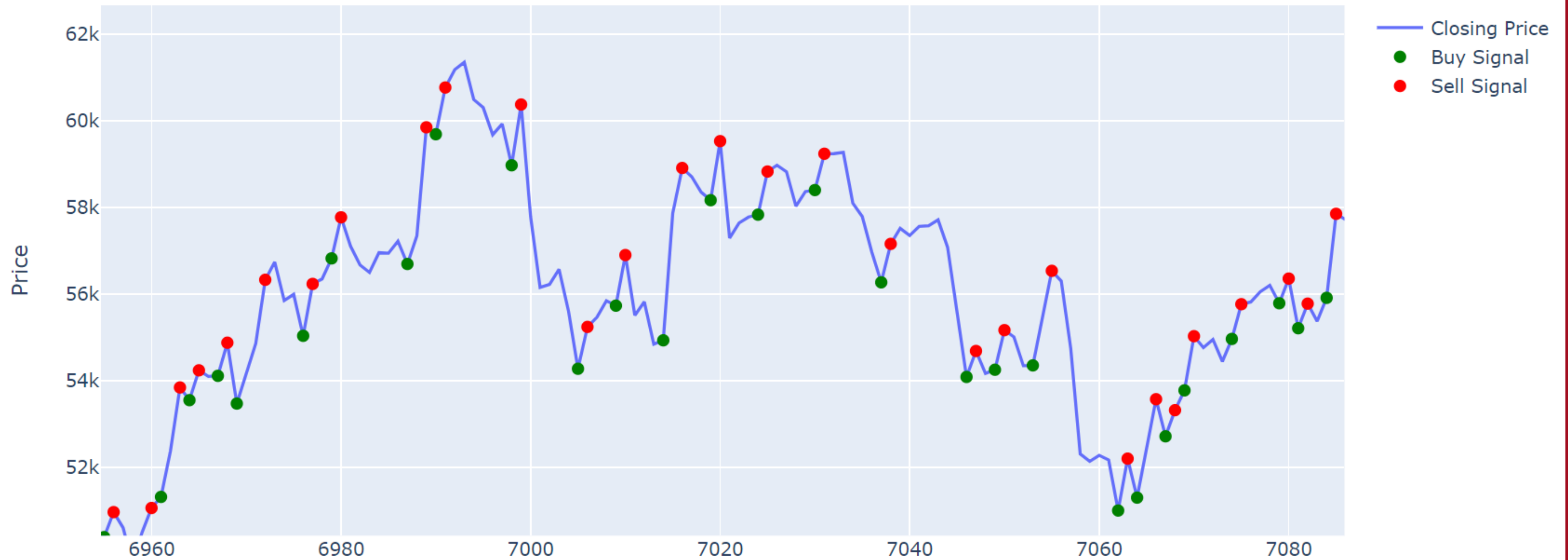


ROC PE Strategy



Strategy : Gap Trading Strategy

Gap Trading Strategy



Gap Trading Strategy

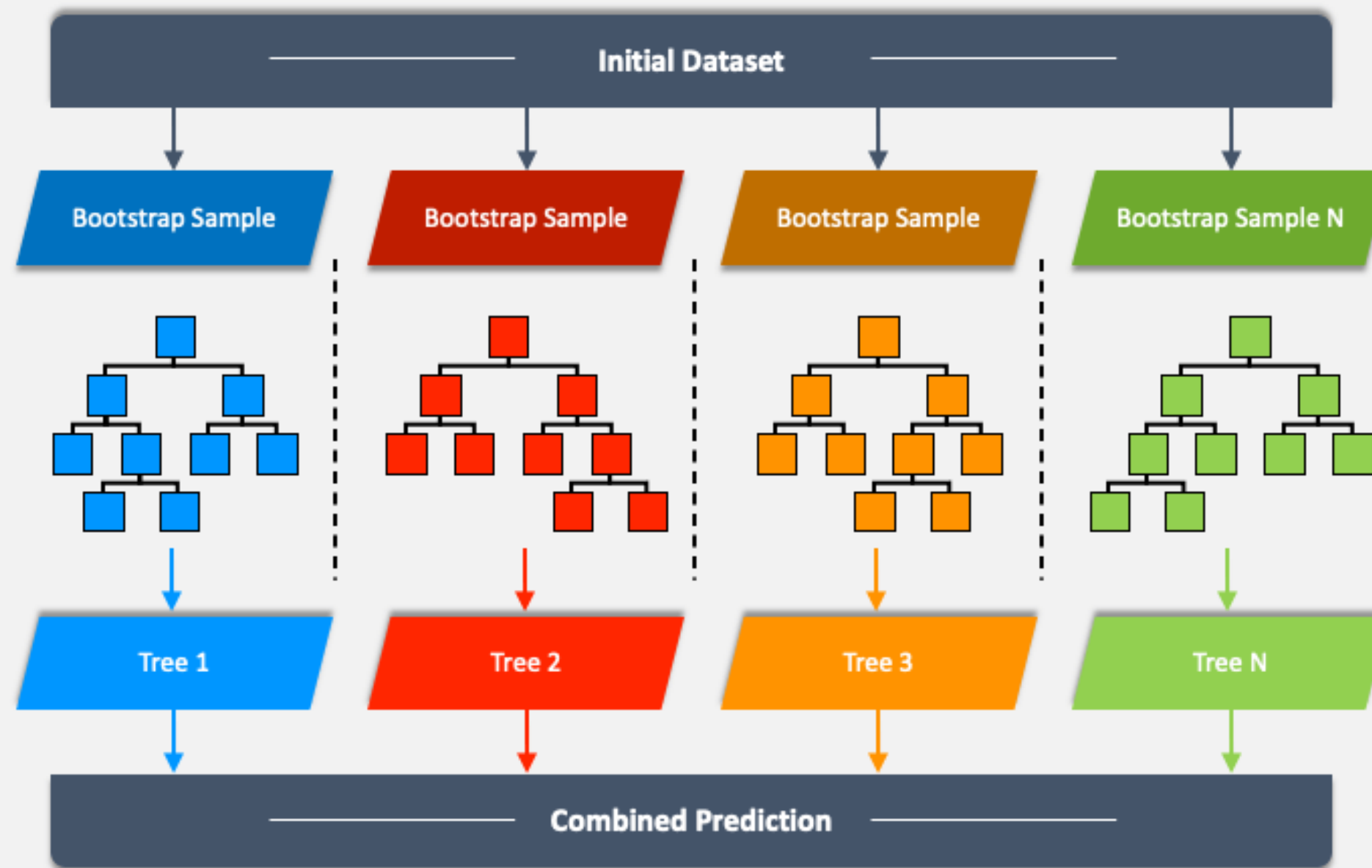
- The strategy aims to identify observations with a **significant gap** between the price of one obs. and the next obs.'s price.
- It then takes trading positions based on whether the gap is positive or negative.
- Positive gaps may trigger a buying position, while negative gaps may trigger a selling position.
- This strategy requires the price of the next observation to take the decision.

	Open	PriceChange	Gap	Position
100	49836.63	-233.73	1.0	1.0
101	50876.71	1040.08	0.0	-1.0
102	51110.56	233.85	0.0	0.0
103	50109.92	-1000.64	0.0	0.0
104	49798.96	-310.96	0.0	0.0
105	49072.12	-726.84	1.0	1.0
106	50210.01	1137.89	1.0	0.0
107	50667.79	457.78	0.0	-1.0
108	50047.84	-619.95	0.0	0.0
109	49626.76	-421.08	0.0	0.0

Regression Model

RANDOM FOREST

Random Forest Algorithm



- Well-known and widely regarded as a powerful machine learning model.

Some Features:

- Ensemble Learning
- Decision Trees
- Bootstrapping

Trading Logic:

We have some indicators that will help explain our strategy.:

1. Position:

position = 1: Represents a long trade, indicating that the algorithm has bought an asset or security.

position = 0: Denotes a neutral position, suggesting that there is no ongoing trade (neither buying nor selling).

position = -1: Corresponds to a short trade, implying that the algorithm has sold an asset.

2. action (The action suggested by the Gap trading strategy):

action = 1: Indicates a signal to buy or initiate a long trade or close a short trade.

action = 0: Represents a hold signal, advising to maintain the current position without taking any new actions.

action = -1: Signifies a signal to sell or initiate a short trade.

Logic:

Long Trade (position $P = 1$ or 0):

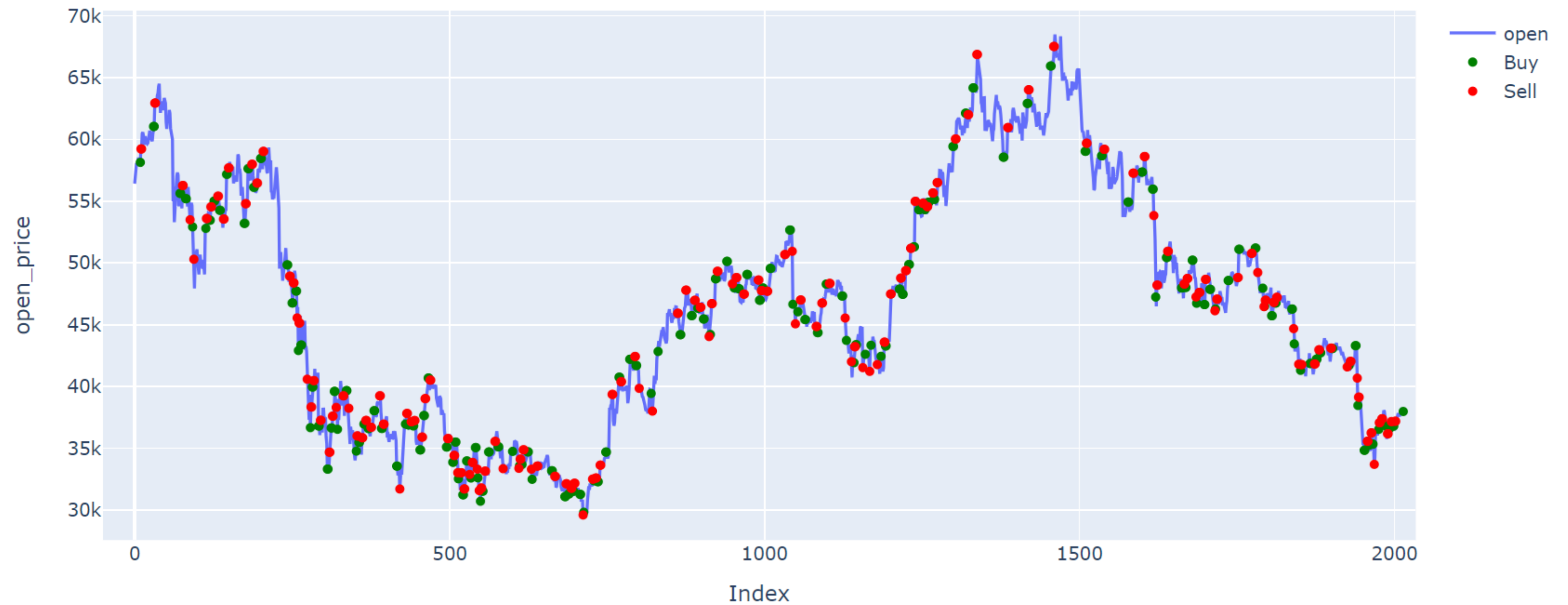
- 1.If $P = 0$ and the action is 1 (Buy), it initiates a long trade. The algorithm purchases the asset.
- 2.If $P = 1$ and the action is -1 (Sell), it ends the long trade and initializes a short trade immediately.
- 3.If the action is 0, it means to maintain the current position without any new buying or selling.
- 4.If the price movement reaches a level that surpasses the stop-loss, the algorithm ends the long trade to minimize losses.

Short Trade (position = -1):

- 1.If the action is 1 (Buy), it closes the short sell position and simultaneously initiates a new long trade.
- 2.If the action is 0, it means to maintain the current position without any new buying or selling.
- 3.If the action is -1, the model maintains the current position of short sell without any new buying or selling. As we use compounding, we don't sell the stocks again.
- 4.If the price movement reaches a level that surpasses the stop-loss, the algorithm ends the short trade and simultaneously initiates a new long trade.

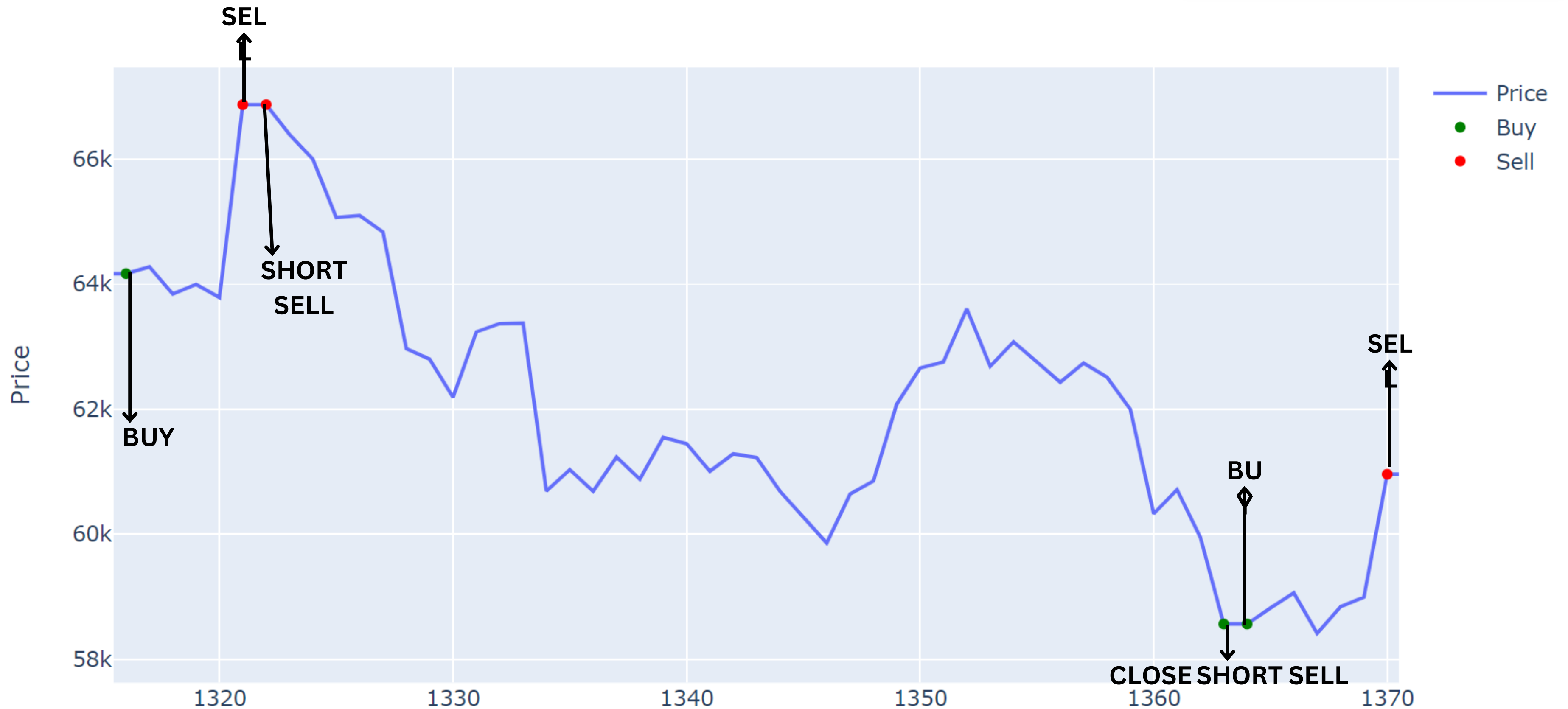
Our Model's Signals

open vs. Action (Buy and Sell)



An Example :-

Price vs. Action (Buy and Sell)



Risk Management

Key Risk Management Strategies:

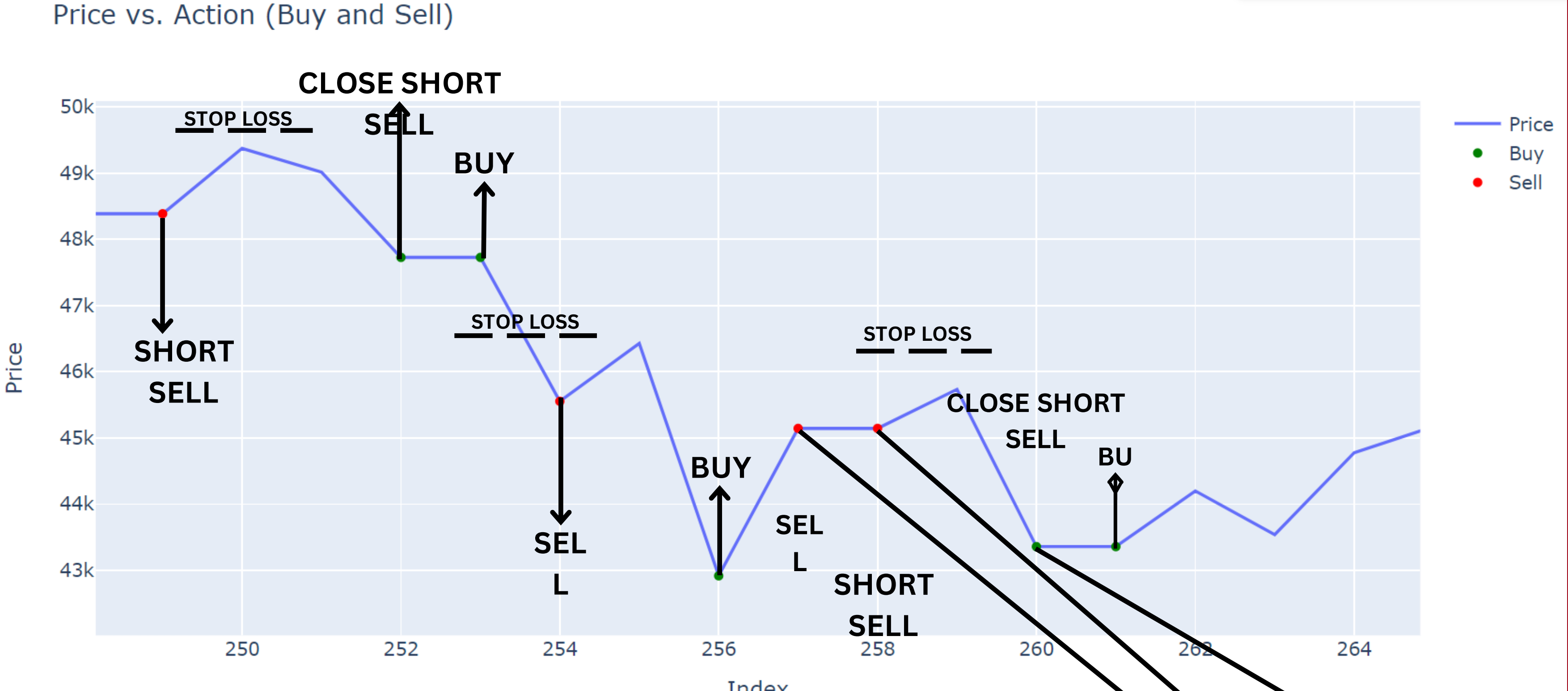
➔ Stop-Loss :

- Set orders to limit potential losses.
- Automatically exits a trade if the market moves unfavorably.

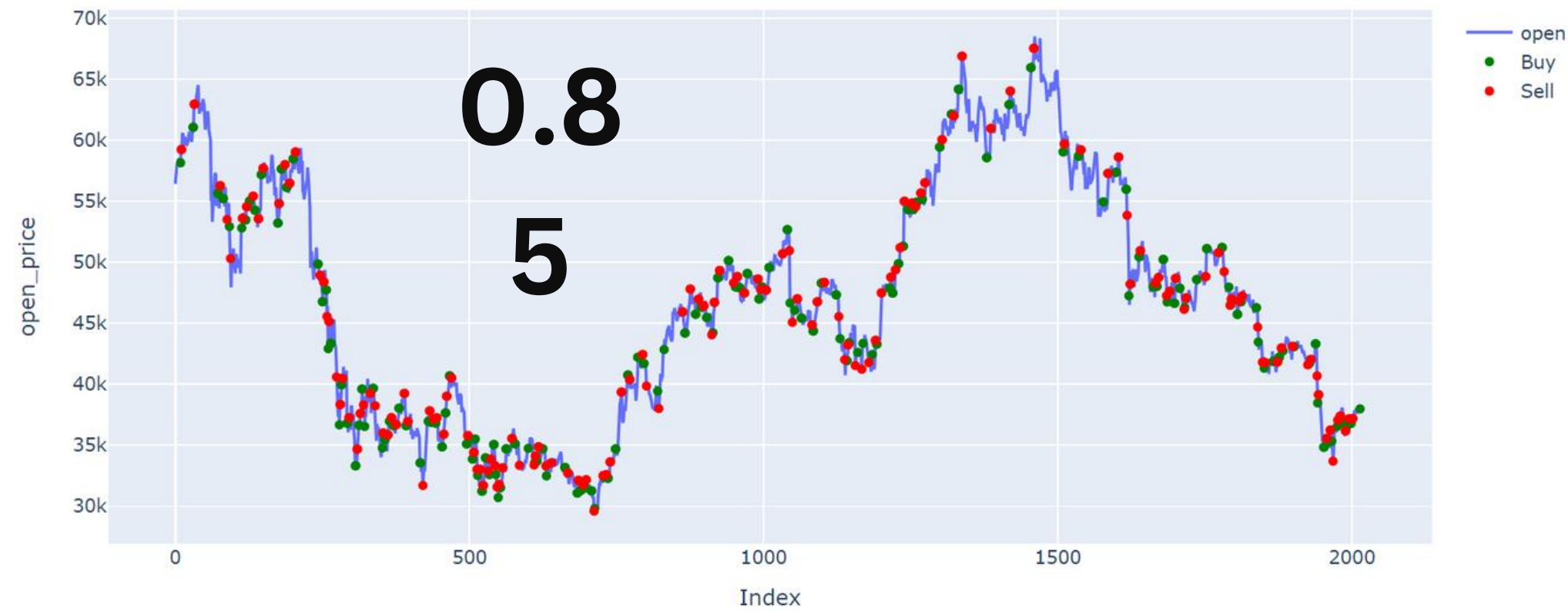
➔ Gap Strategy Threshold:

- Influences the identification of price gaps in the strategy.
- A higher threshold might result in fewer gaps being identified and lenient trading, while a lower threshold could lead to more gaps being considered significant and more rigorous trading.
- Adjusting this parameter allows users to customize the sensitivity of the strategy to price movements, catering to different preferences or market conditions.

STOP LOSS

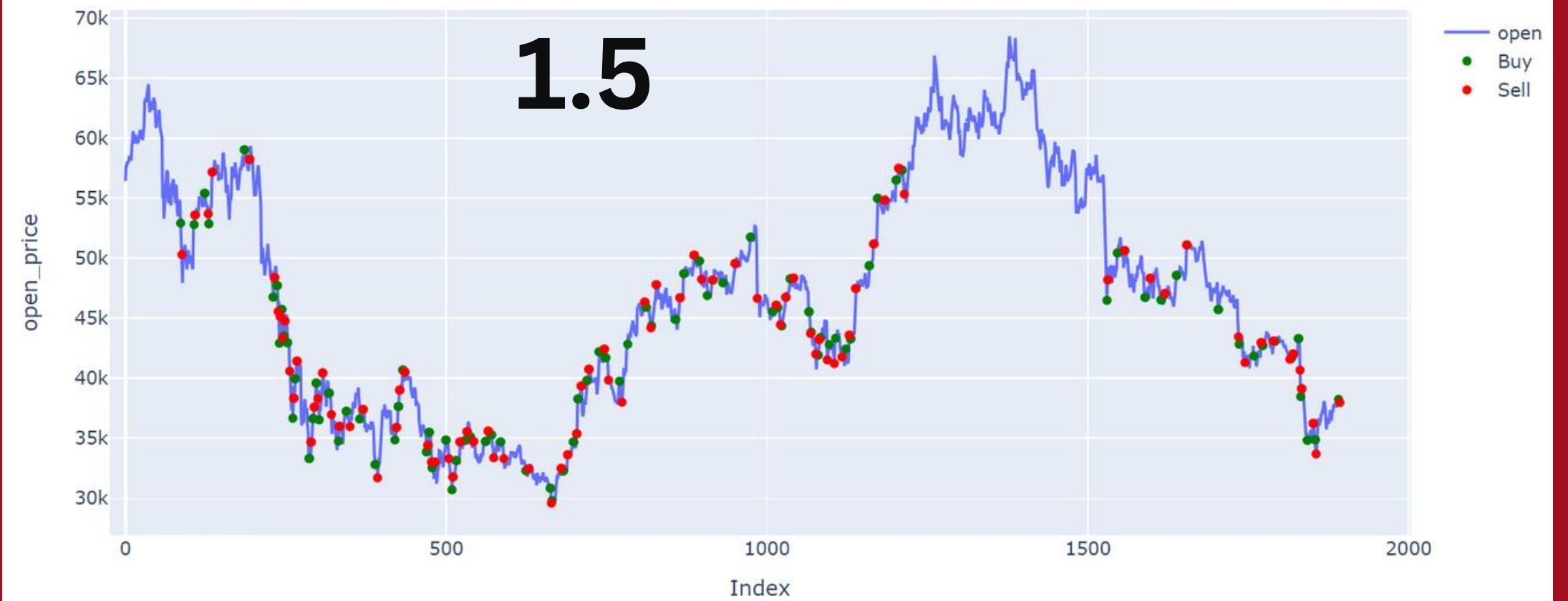


open vs. Action (Buy and Sell)



Gap Strategy Threshold

open vs. Action (Buy and Sell)



Backtesting

Parameters :

1. ML model Parameters (Random Forest))
2. gap-threshold-percentage = 0.85
3. stop-loss-percentage = 0.30
4. Look-Back Window = 10 Obs.

```
regressor = RandomForestRegressor(n_estimators=100,  
                                  max_depth=None,  
                                  min_samples_split=2,  
                                  criterion="squared_error",  
                                  min_samples_leaf=1,  
                                  min_weight_fraction_leaf=0.0,  
                                  max_features="auto",  
                                  max_leaf_nodes=None,  
                                  min_impurity_decrease=0.0,  
                                  bootstrap=True,  
                                  oob_score=False,  
                                  n_jobs=None,  
                                  verbose=0,  
                                  warm_start=False,  
                                  ccp_alpha=0.0,  
                                  max_samples=None,  
                                  random_state=12)
```

gap-threshold-percentage' and 'stop-loss-percentage'

GAP THRESHOLD PERCENT	0.85	1.05	1.05	1.05	1.05	1.15	1.25	0.95
STOP LOSS PERCENT	0.03	0.03	0.025	0.02	0.015	0.03	0.03	0.03
Gross Profit	1484430.98	1205953.12	918789.01	722692.13	635505.56	813260.73	809006.2	1157908.51
Net Profit	483996.36	377471.22	243280.95	135608.71	111172.07	244088.81	255588.79	403950.14
Gross Loss	-1000434.62	-828481.9	-675508.06	-587083.42	-524333.49	-569171.91	-553417.41	-753958.38
Max Drawdown	-35734.68	-28400.55	-19616.06	-14403.88	-17808.16	-19175.64	-19816.51	-27285.13
Max Drawdown Percentage	-6.28%	-6.46%	-6.46%	-8.01%	-8.01%	-6.46%	-6.46%	-6.28%
Buy and Hold Return of BTC	484.00%	377.47%	243.28%	135.61%	111.17%	244.09%	255.59%	403.95%
Sharpe Ratio	1.2384	1.0213	1.3197	1.4937	1.4544	1.4435	1.4657	0.9189
Sortino Ratio	112.3862	30.7782	24.7393	19.2891	21.4109	25.7558	24.0641	21.8001
Total Closed Trades	268	239	237	244	236	210	198	251
Number of Winning Trades	171	149	141	139	126	131	121	161
Number of Losing Trades	97	90	96	105	110	79	77	90
Average Winning Trade	8680.88	8093.65	6516.23	5199.22	5043.69	6208.1	6686	7191.98
Average Losing Trade	-10313.76	-9205.35	-7036.54	-5591.27	-4766.67	-7204.71	-7187.24	-8377.32
Largest Winning Trade	54753.93	49122.83	33928.79	26813.7	28724.57	33167.02	34275.51	46754.29
Largest Losing Trade	-35734.68	-28400.55	-19616.06	-14403.88	-17808.16	-19175.64	-19816.51	-27285.13
Average Holding Duration	24.06 hrs	25.67 hrs	22.58 hrs	19.69 hrs	16.58 hrs	24.84 hrs	25.31 hrs	24.48 hrs

Overall Results

1. Gross Profit: **1484430.98**
2. Net Profit: **483996.36**
3. Gross Loss: **-1000434.62**
4. Max Drawdown: **-35734.62**
5. Buy and Hold Return of BTC: **484.00%**
6. Sharpe Ratio: **1.2384**
7. Sortino Ratio: **112.3862**
8. Total Closed Trades: **268**
9. Number of Winning Trades: **171**
10. Number of Losing Trades: **97**
11. Average Winning Trade (in USDT): **8680.88**
12. Average Losing Trade (in USDT): **-10313.76**
13. Largest Winning Trade (in USDT): **54753.93**
14. Largest Losing Trade (in USDT): **-35734.68**
15. Average Holding Duration per Trade: **29.97 hrs**
16. Max Drawdown Percentage: **6.28%**

Random Forest Results

Train Set Metrics:

R2 Score: **0.9998820645527133**

Mean Squared Error: **14760.061048243917**

Mean Absolute Error: **54.92394429652503**

Test Set Metrics:

R2 Score: **0.9693747358366076**

Mean Squared Error: **2456163.9950162075**

Mean Absolute Error: **1038.8512681053812**

Conclusion:

- Built an Algo trading model .
- On the Historical BTC/USDT 4hrs data from January 1, 2018 to January 31, 2022
- With the help of Random Forest , a simple yet powerful machine learning model.
- Using a Gap Trading Strategy method.
- To generate 448% return along with the max drawdown of 6.28%.