

Machine Learning Algorithmic Trader



Presented Jan 13, 2022 by Team 4 (Pat Beeson, Scott Oziros and Sumeet Vaidya)

Executive Summary

Overview

We completed an end-to-end machine learning project of algorithmic trading strategies. The project spans from ideation and feature engineering to model optimization, strategy design and backtesting. In addition to meeting our goal of identifying a profitable active trading strategy, we also deepened our proficiency and confidence in this challenging area of FinTech.

Signals

The project developed strategies to validate and predict entry and exits points of the Investco QQQ ETF using two technical indicators, SMA Crossover and Bollinger Bands. We then compared the results. We evaluated and backtested several machine learning libraries and selected the two with the highest accuracy.

ML

We found the best results from using a combination of Deep Neural Multilayer Perceptron (MLP), Long Short-term Memory (LSTM) and a Support Vector Machine (SVM). By backtesting simulated historical trades we concluded Bollinger Bands outperforms SMA crossover. With additional effort we could test our theory that combining Bollinger Bands with another technical indicator would outperform the single technical indicator alone.

Robo-Advisor

Finally we provide a beta integration of an Amazon Lex Chatbox and Slack to pass a predictive trade signal directly to a user's fingertips.

We hope you enjoy our presentation!

Approach to achieving project goals

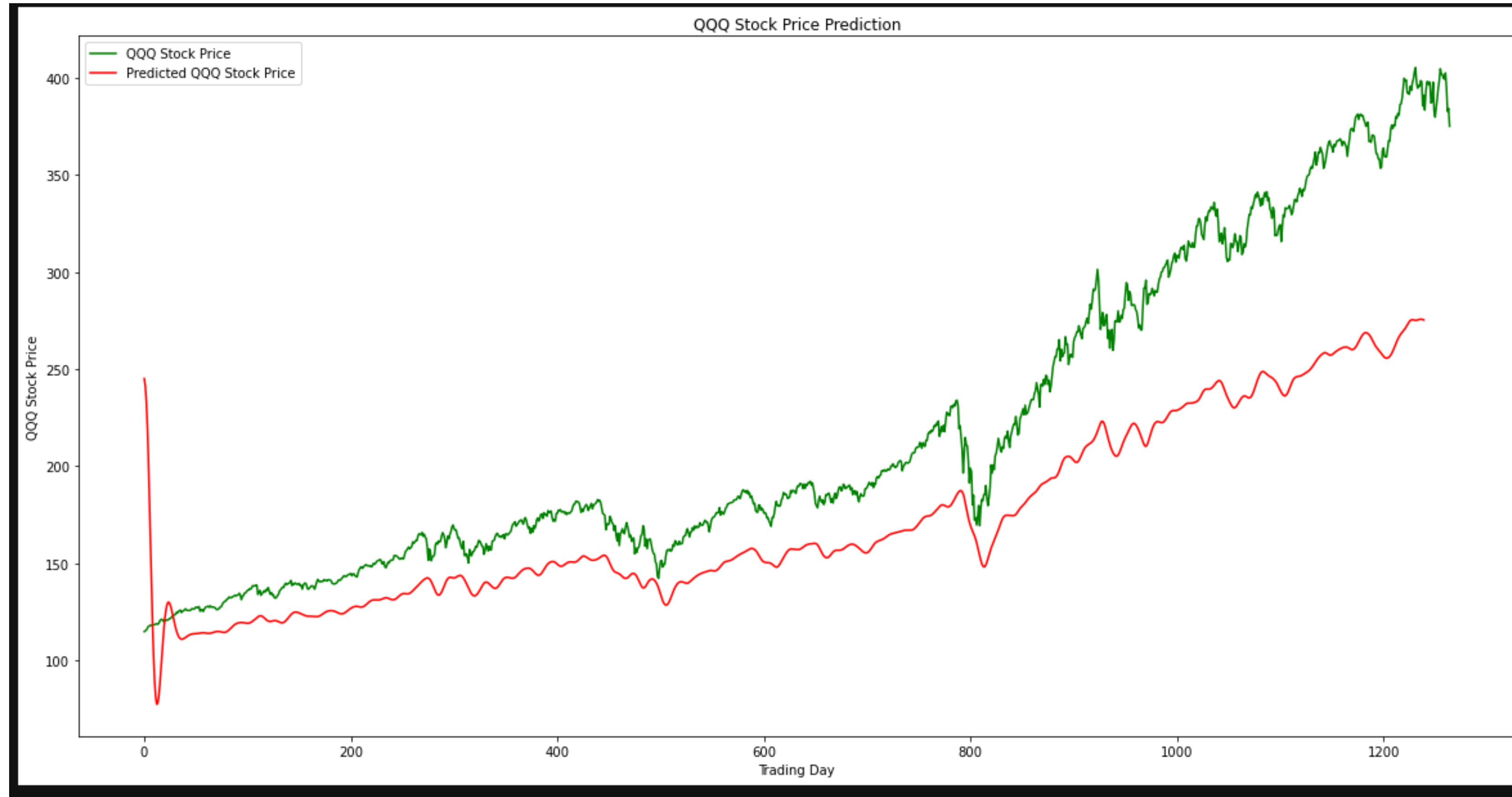
Overview of completed steps

- Realtime Data
 - API to yFinance to pull 10 years historical data
 - Calculate the daily return price
- Trading Signal Algo
 - Optimize short and long windows (7, 25)
 - Set signal to 1 when the current price is higher than previous day closing price
 - Set signal to -1 when the current price is lower than previous day closing price
 - Calculate the strategy returns by multiplying the actuals returns by the signal (1, -1)
 - Use SMA short and SMA long windows as features
 - Use Bollinger Bands price channels as features
- Machine Learning
 - Create the target set by selecting the categorical signal
 - Set the training period
 - Optimize the training period (85% of data)
 - Set and optimize the test set (3 months)
 - Use Standard Scaler to scale data
 - Fit the data to the model
 - Evaluate the accuracy score (train/test)
 - Predict and compare the strategy returns against actual returns
- Backtest algorithms against historical data

Data preparation and training process

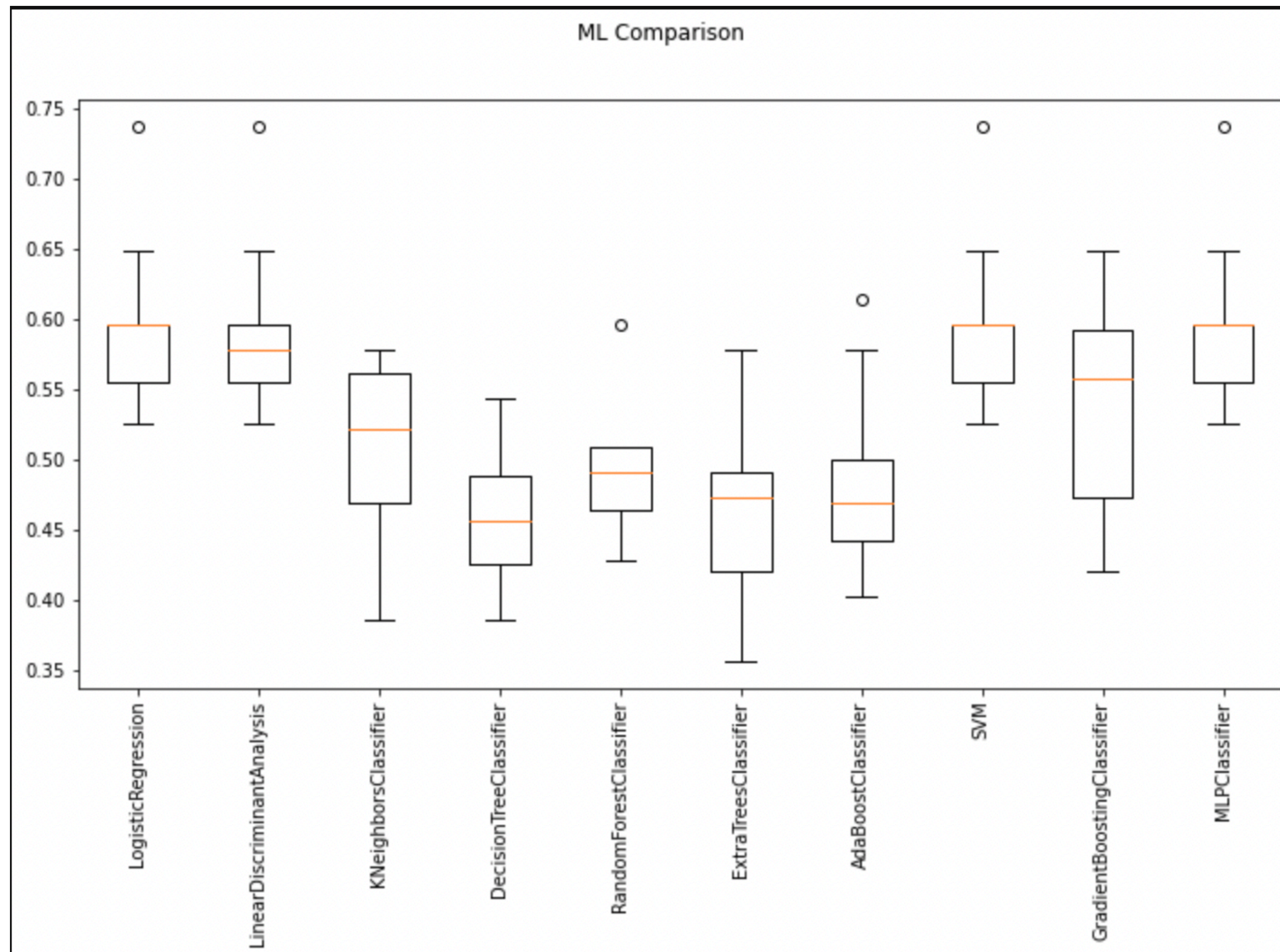
- Steps to Build a Machine Learning Model
 - Collect Data (yf, alpaca, alpha vantage)
 - Prepare the data
 - Choose the model (SVM, LSTM, LR)
 - Train the model
 - Evaluation
 - Parameter Tuning
 - Prediction or Inference

LSTM price prediction



ML models

Evaluation and description of various ML classifiers



Comparisons

Results of Backtesting

	SMA	BB
Initial Investment	\$100,000	\$100,000
Ending Balance	\$211,460	\$226,764
Net Profit	\$111,460	\$126,764
% Gain	111%	127%
Exposure %	20% -90%	20% -90%
Avg Trade Profit	\$4,231	\$4,217
Avg Trade Loss	(\$1,636)	(\$1,676)
Max Win	\$36,950	\$19,029
Max Loss	(\$5,098)	(\$5,309)

# of Trades	Count	Count
Wins	35	22
Losses	23	5
Total Trades	58	27
W/L Ratio	1.5	4.4

Annualized Return	7.80%	8.50%
Cumulative Return	111%	124%
Annual Volatility	7.90%	9.60%
Sharpe Ratio	0.98%	0.89%

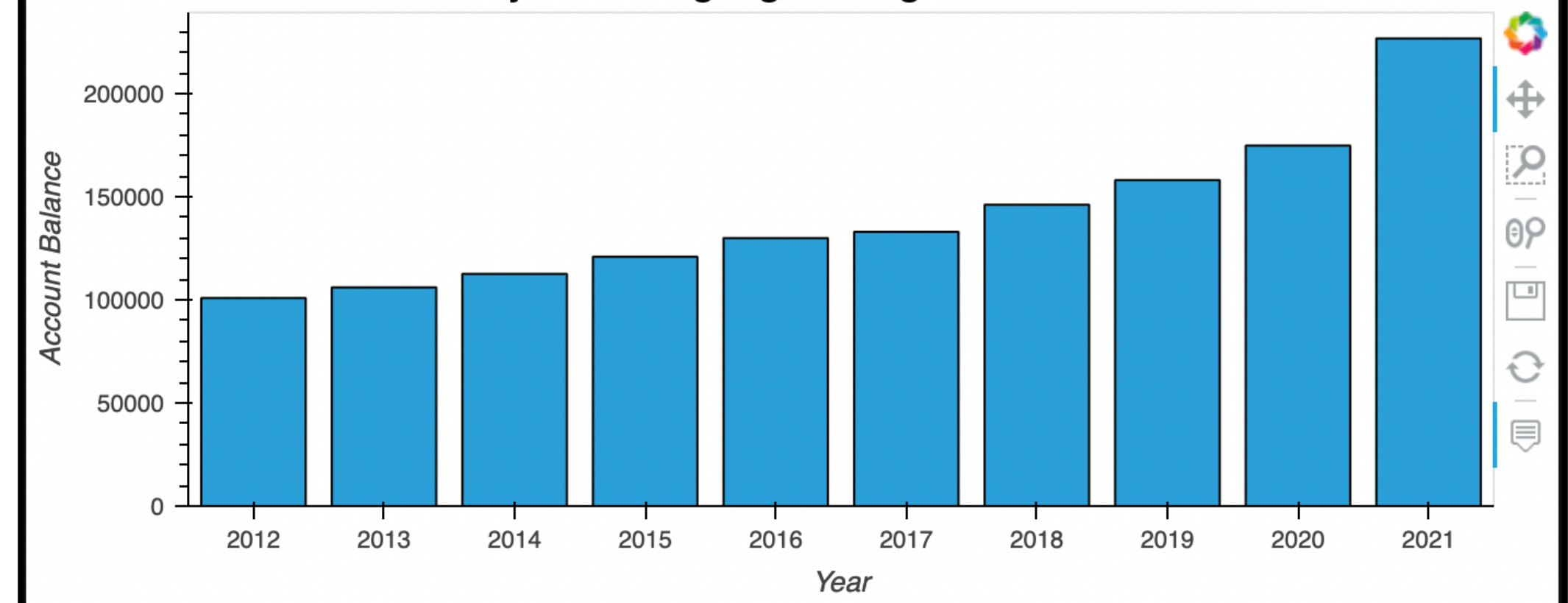
Trade P/L

	SMA	BB
Total Profit	\$111,460	\$126,764
Trade Fees	(\$580.00)	(\$270.00)
Taxes	(16,719)	(19,015)
Net Income	\$94,161	\$107,479

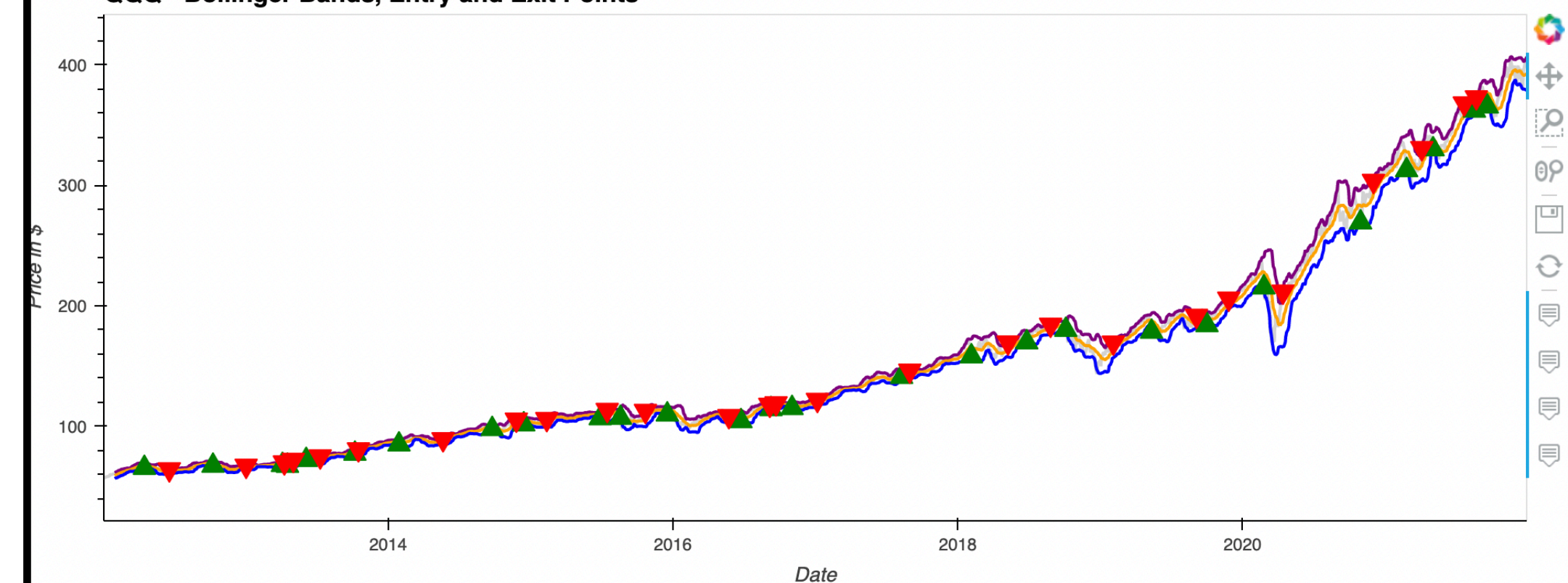
Benchmark - (B/H)

Annualized	22.74%
Sharpe Ratio	1.37%

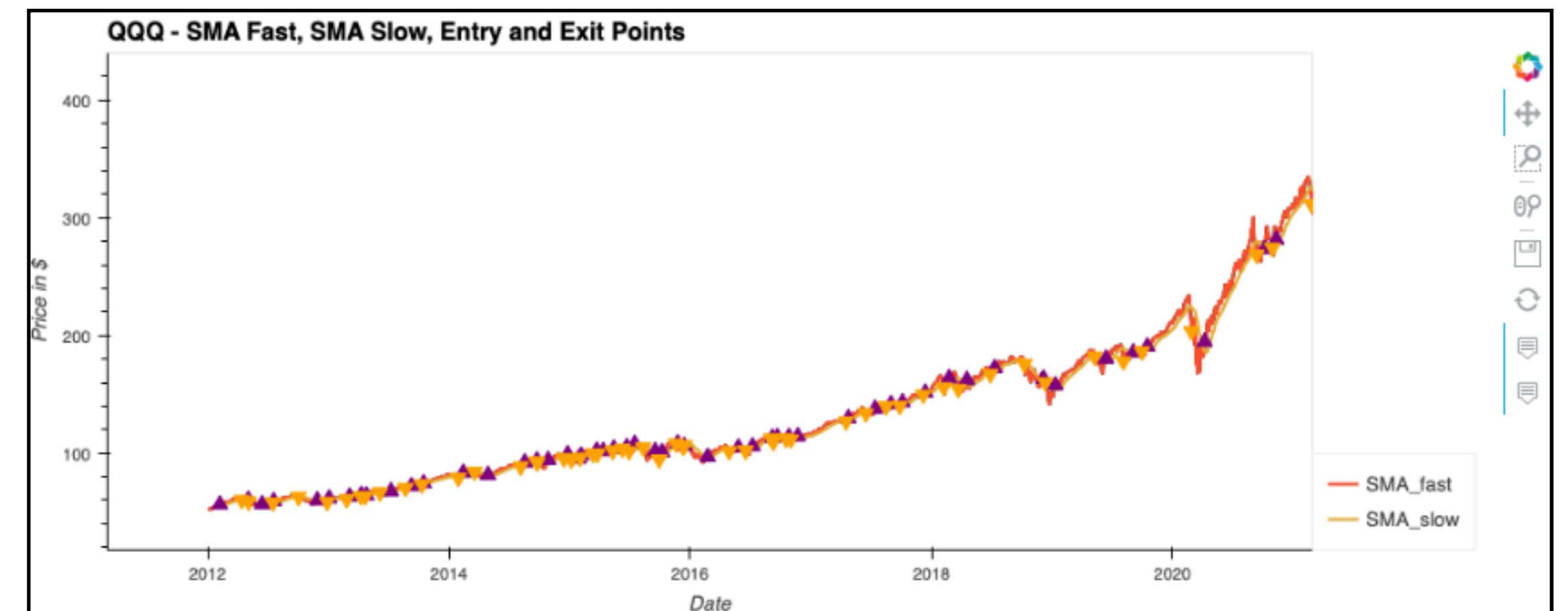
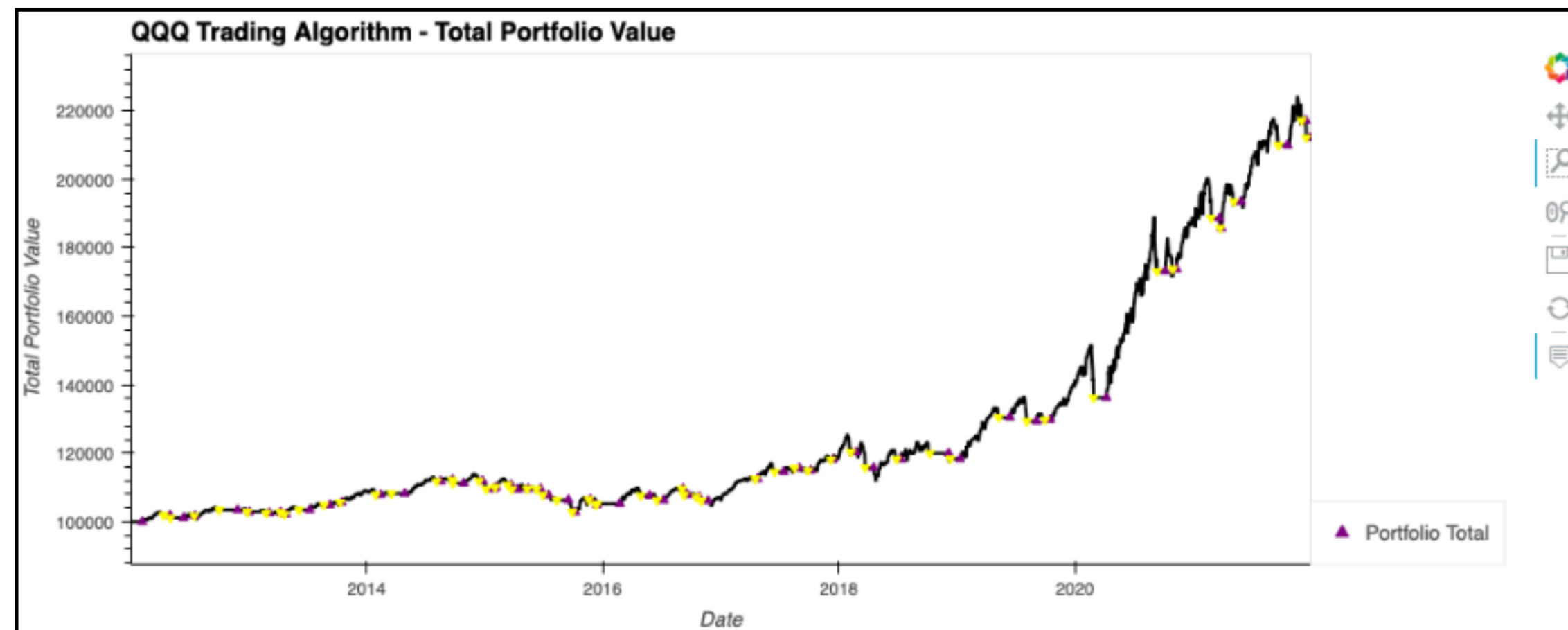
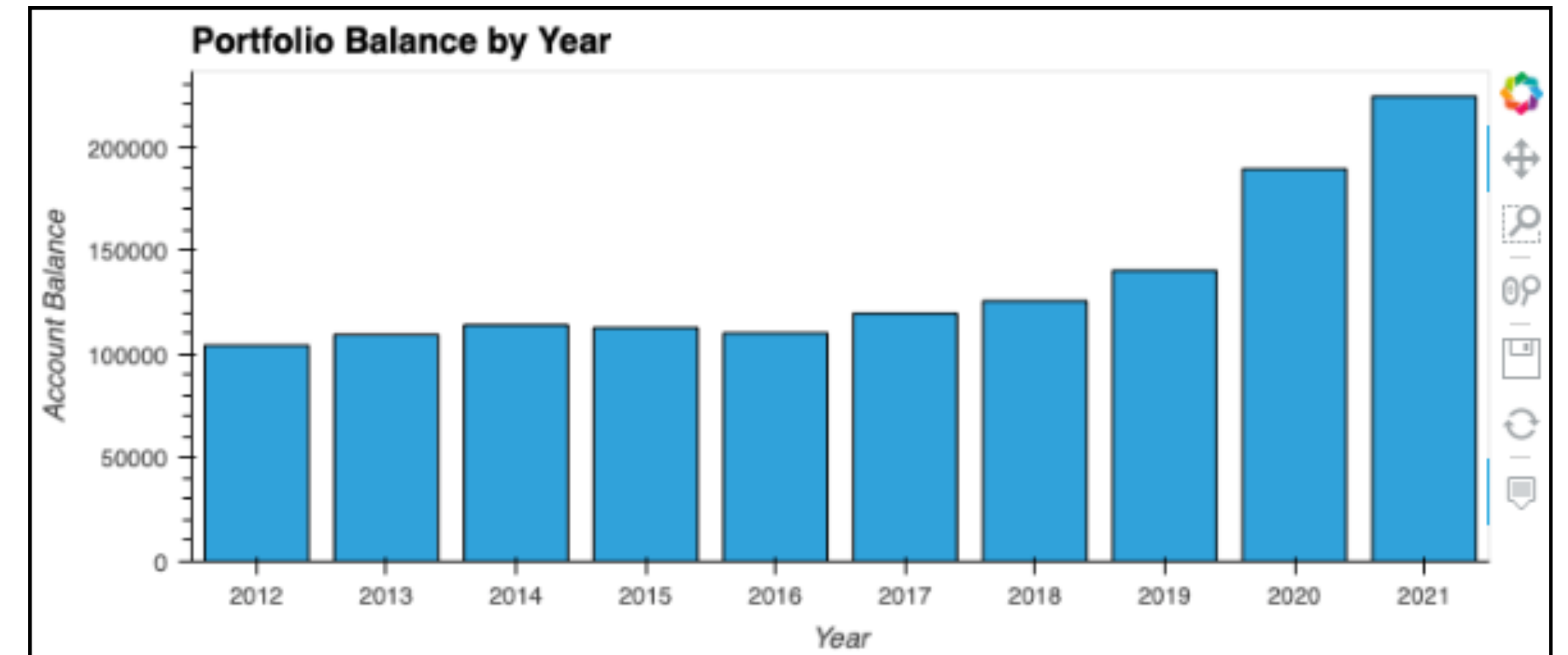
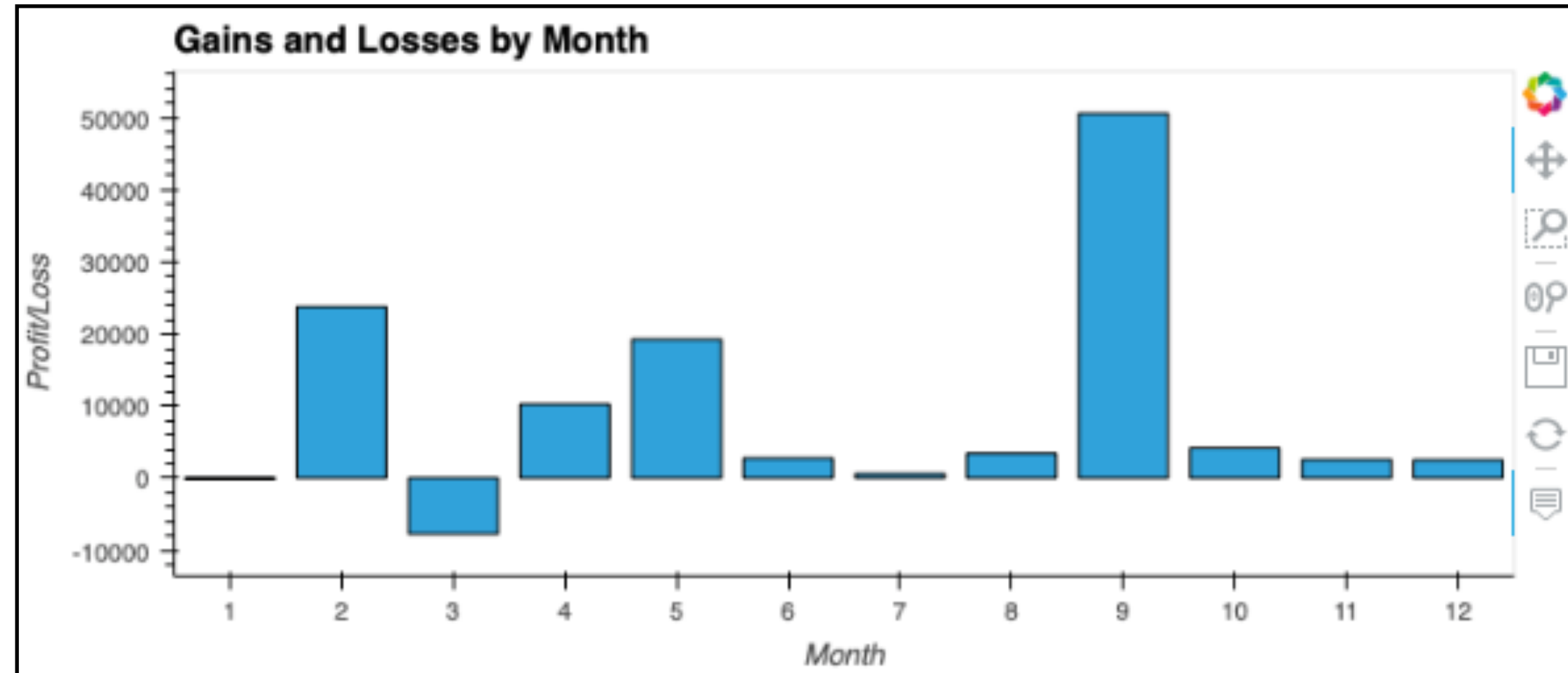
Portfolio Balance by Year using Algo Bolinger Bands



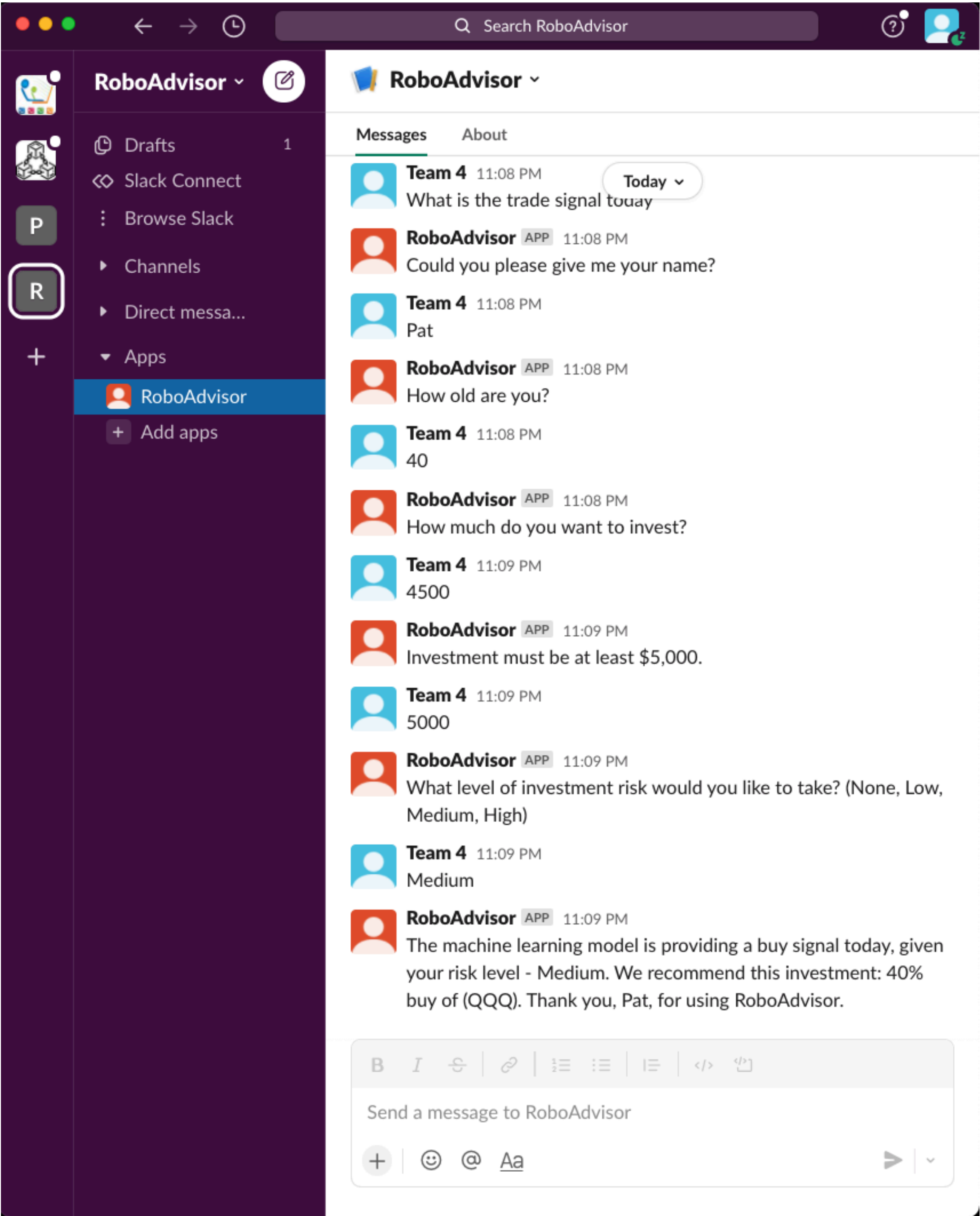
QQQ - Bollinger Bands, Entry and Exit Points



SMA Crossover plots



Integration of Slack and AWS Lex



- Upcoming Features:**
- ✓ Upload model to AWS S3 bucket
 - ✓ Pass most recent trade signal to Lex via Lambda function

Next steps if more time

- Combine single technical indicator strategy with another technical indicator such as Bollinger Bands, RSI etc.
- Build out AWS Lex RoboAdvisor Slack integration to pass predictive signal

- Github repository
- Scikit-learn, Keras, Tensor Flow
- Finta
- Pandas, Numpy
- Yahoo!Finance