

Setup and Process Explanation:

I started by focusing on the backend of the application, using the `pandas_ta` and `yfinance` Python libraries to fetch real stock data for analysis. Initially ensured I understood the structure of the `yfinance` (yahoo finance api python wrapper), then added the original breakout strategy. From there I worked on the front end utilizing StreamLit library. Once I had a basic working prototype, started testing basic functionality to find and fix bugs such as start date or end date being on a non-stock trading day.

Non stock trading day being selected as start or end date will result in program updating the selected date to seek the immediate next day that has valid stock trading information. Any change in start or end dates are recorded in the results.

A major roadblock I encountered was getting accustomed to using the StreamLit library for the front-end and debugging any issues that arose in integrating StreamLit.

To address lookahead bias, only forward fill was used on technical analysis that did not have enough information within the select dates and rolling averages were ensured to not be center and require a period of minimum length equal to the window of the rolling average.

- **Original breakout strategy and frontend setup: ~3 hours**
 - Initial rough draft of mvp starting with mesop swapping to streamlit ~1hr
 - Debugging various issues with streamlit, nontrading days ~2hr
- **Adding additional indicators and polishing elements (e.g., progress bar): ~3 hours**
 - Adding RSI, MACD, ATR, , Bollinger Bands, OBV ~1hr
 - Adding Keltner Channels, Volume Weighted Average Price, Rate of Change, Percentage Price Oscillator, Chaikin Money Flow, volume profile (sma, std dev) ~1.5hrs
 - Adding polishing elements such individual chart displays that are each downloadable for original breakout strategy and each combination of strategy, adding progress bar so user isn't left in dark while program is processing, adding combined download button that will include all strategies with results ~30minutes
- **Setting up and deploying Streamlit, writing documentation: ~1hr**
- **Total time spent ~7hrs**

Realize that the extra credit originally stated only asking what other indicators one would use, however I really enjoyed the project and adding additional indicators and ui features.

Extra Credit – Additional Strategies and Insights:

In addition to the original breakout strategy, I experimented with various other technical indicators to create combined strategies:

- **Momentum Volume Strategy:** Combining momentum with volume indicators like momentum, volume profile, and volume change > 1.0 .
- **Trend Confirmation Strategy:** Using MACD (Moving Average Convergence Divergence) and RSI (Relative Strength Index) to confirm the overall trend.
- **Volatility Breakout Strategy:** Implementing Keltner Channels, Bollinger Bands, and Average True Range (ATR) to capture price volatility.
- **Volume Price Breakout Strategy:** Incorporating on-book volume, volume profile, and VWAP (Volume Weighted Average Price) to identify breakouts.

Additionally, I combined these strategies to create "combo strategies" such as the combination of the original breakout with momentum, volume, and volatility indicators.

Observations and Results:

While the original breakout strategy does show potential, it wasn't consistently profitable on its own. One adjustment I made was lowering the threshold for the percent volume breakout to 100% (from 200%) and increasing the holding period to 20 days. This improved results slightly but still lacked consistency in my anecdotal testing. Input parameters + strategies that worked on AAPL would not necessarily work on GOOG, MSFT, INTC, and similar stocks and vice versa for the same time period. It was at this point that I added the additional indicators in hopes of seeing some overlap in positive returns between different strategies while culling the negative return days of any one particular strategy utilized.

Original breakout strategy with given thresholds usually results in limited buy dates. For AAPL in from January 1 2020 to January 1 2024 there were no buy dates under original breakout strategy, extending the range to start in January 1 2014 resulted in 4 buy days with sum return of 2.28%.

For comparison, the momentum volume and volume price strategies had 35.39% and 9.24% returns for January 1 2020 to January 1 2024 for AAPL. Using January 1 2014 to January 1 2024 momentum volume summed returns reduced to 30.58% while volume price summed returns increased to 22.94%

Switching to using GOOG for testing, there were miniscule positive returns utilizing momentum volume (1.87%) and volume price strategies (9.37%) for January 1 2020 to January 1 2024. However, changing the start to January 1 2014, resulted in negative returns; for original strategy in project -13.98%, for momentum volume -25.01%, for volume price -20.90%.

The combinations of the **Momentum Volume** and **Volume Price Breakout** strategies, as well as the **Momentum Volume** and **Trend Confirmation Breakout** strategies, showed promising results but still struggled to produce consistent returns across different stocks, date ranges, and threshold settings.

Ideas for Improvement:

- Including industry of stock to tie strategies to specific industry/industries
 - Also to include industry of stock as part of feature engineering when utilizing machine learning
- Parallel Processing for Scalability
 - (ideally paired with performance benchmarking to get better general idea of stock trading strategy potential results/returns)
- Sentiment analysis based on financial news and/or social media
 - Sentiment analysis could also be utilized as part of feature engineering when developing machine learning strategies
- Machine Learning for Strategy Optimization
- Adding option for risk management strategy/strategies vs flat hold period
 - (e.g. stop loss or trailing stop at 2x ATR)
- Performance benchmarking against major indexes such as S&P 500
- Hyper Parameter Tuning (such as grid or random forest)