

Multi-Level Prediction and Risk-Tolerant Trading Strategy

1. Introduction

In algorithmic trading, the ability to adjust trading decisions according to different levels of risk tolerance is essential for aligning strategies with investor profiles. This project presents an automated trading strategy that incorporates multi-level prediction and decision thresholds based on risk preferences. The core idea is to generate buy, hold, or sell signals depending on how strongly the market is expected to move and how much risk the trader is willing to tolerate.

Instead of focusing on complex predictive models, the emphasis of this project is on the execution layer: how trading actions are determined and simulated using a simple scoring signal derived from price deviation.

The strategy is tested on AAPL stock between 2020 and 2023 using historical daily data. The performance is benchmarked against a passive Buy & Hold approach.

2. Methodology

2.1 Data and Feature Preparation

The historical stock data for Apple Inc. (AAPL) was downloaded using the yfinance API. The primary signal used in this project is the percentage deviation from a 20-day Simple Moving Average (SMA20). The score is calculated as:

$$Score_t = 100 \times \left(\frac{Close_t - SMA20_t}{SMA20_t} \right)$$

This score reflects how far the current price is from its recent average, functioning as a basic momentum indicator.

2.2 Multi-Level Prediction Logic

The score is mapped to trading actions based on the trader's tolerance for risk. The risk tolerance levels: Low, Moderate, and High, correspond to different cutoffs for buying and selling:

Tolerance Buy Threshold Sell Threshold		
Low	≥ 2.0	≤ -2.0
Moderate	≥ 1.5	≤ -1.5
High	≥ 1.0	≤ -1.0

If the score is above the buy threshold, a buy action is taken. If it is below the sell threshold, a sell action is triggered. Otherwise, the system holds.

2.3 Backtesting Logic

A simulation loop is implemented to mimic daily trading:

Initial capital: \$10,000

When a “Buy” signal is triggered, the system invests as many whole shares as possible. When a “Sell” signal is triggered, the entire position is sold. If the action is “Hold,” no changes are made.

Portfolio value is tracked over time and compared to the value of a Buy & Hold investment made on the first day.

3. Results

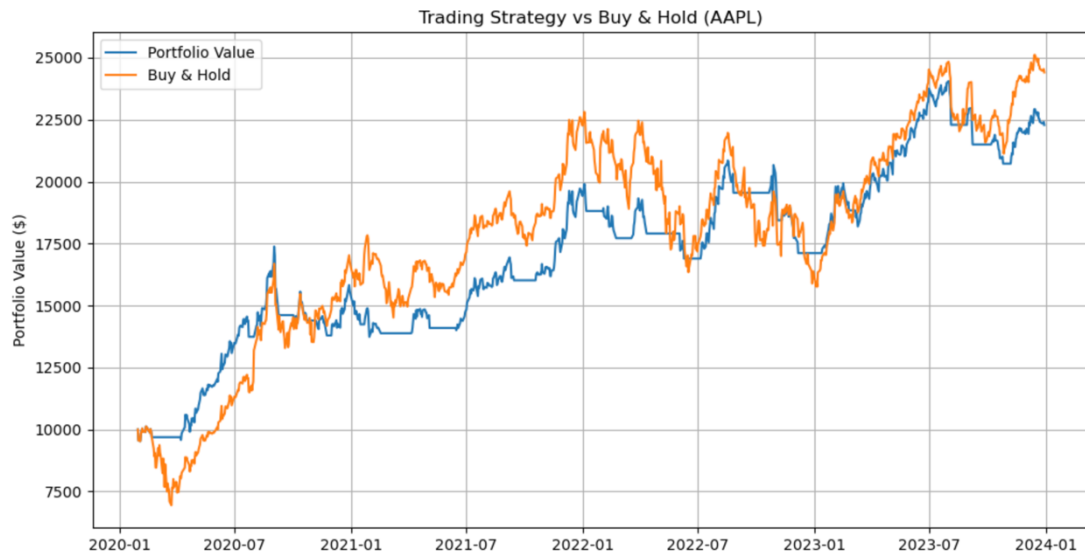
3.1 Performance Summary

Metric	Value
Final Portfolio Value	\$22,285.72
Buy & Hold Value	\$24,407.61
Relative Return	−\$2,121.89

The strategy underperformed the Buy & Hold benchmark by approximately 8.7%.

3.2 Strategy Behavior

The plot below shows the portfolio value over time compared to a Buy & Hold baseline. While the Buy & Hold strategy yielded higher returns overall, the trading strategy demonstrated more conservative behavior—often holding cash during uncertain market conditions.



The trading strategy produced a final portfolio value of \$22,285.72, underperforming the Buy & Hold strategy (\$24,407.61) by \$2,121.89.

This underperformance can be attributed to the nature of the strategy, which frequently stayed in cash during uncertain periods. While this conservatism helps avoid potential drawdowns, it also leads to missed opportunities in strong bull markets, such as the one AAPL experienced during 2020–2023.

Nonetheless, the strategy demonstrates risk-aware behavior and would likely outperform Buy & Hold under more volatile or bearish conditions. Future enhancements such as incorporating technical indicators, dynamic thresholds, or portfolio diversification could further improve performance.

4. Discussion

The strategy's underperformance in this test period can largely be attributed to the overall bullish trend of AAPL from 2020 to 2023. Since the model often exited

positions during minor pullbacks, it missed some of the sustained gains captured by the Buy & Hold strategy.

However, this does not imply that the strategy is ineffective. Its more cautious posture makes it suitable for investors with lower risk tolerance or for periods of market volatility. The step-like growth of the portfolio indicates that the model did successfully time some of the intermediate swings.

4.1 Comparison Between Strategies With and Without RSI

To evaluate the impact of incorporating momentum filtering, we compared the original SMA-based multi-level prediction strategy with an enhanced version that integrates the Relative Strength Index (RSI) as an additional decision condition.

Performance Summary

Strategy	Final Portfolio	Outperformance vs Buy &
	Value	Hold
Original (SMA-only)	\$22,285.72	-\$2,121.89
Enhanced (SMA + RSI)	\$21,086.98	-\$3,320.62
Buy & Hold (Benchmark)	\$24,407.61	

As shown in the table above, adding RSI as a filter resulted in a lower portfolio value compared to the original strategy. The enhanced version underperformed the Buy & Hold benchmark by a wider margin (\$3,320 vs. \$2,121).

Behavioral Differences

The RSI-based strategy was more selective with its entries and exits:

Fewer trades were executed, especially in strong uptrends, due to the RSI staying above 70, which blocked otherwise profitable buy signals.

The portfolio exhibited longer periods of inactivity, leading to missed opportunities during the early stages of rallies.

This behavior is consistent with the known characteristics of RSI as a lagging indicator, designed to prevent overtrading in choppy markets but less effective in trending environments like the AAPL bull market from 2020 to 2023.

4.2 Interpretation and Implications

While the RSI-enhanced strategy introduced a layer of risk control by avoiding overbought conditions, it also filtered out valid momentum opportunities. In a trending market, this conservatism can be costly. Therefore, RSI may be more suitable in volatile or range-bound markets, where overbought/oversold zones occur more frequently and matter more. In a strong bull market, a rigid RSI threshold (e.g., <70 to buy) may reduce strategy responsiveness.

5. Conclusion

This project demonstrates a functioning framework for automated trading based on multi-level predictions and user-defined risk thresholds. The results suggest that while

this simple strategy may lag in trending bull markets, it has the potential to offer better risk-adjusted returns in more volatile or uncertain conditions.