Presented by: Deborah Xing

Mentor: James Dufresne

WiM DRP Research Program

EVALUATING TECHNICAL INDICATORS IN FINANCIAL MARKETS

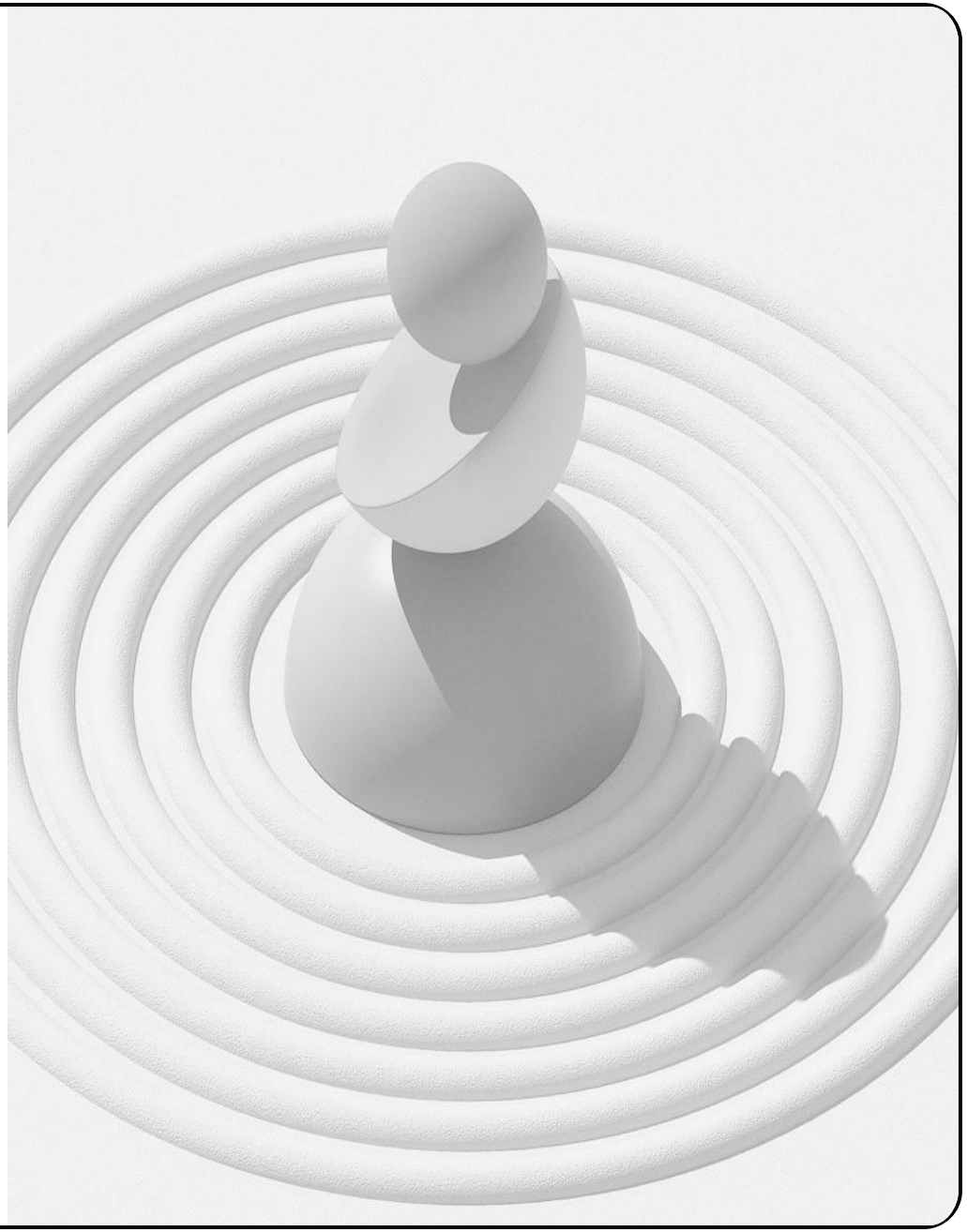
RESEARCH QUESTION

Research Question:

- Which technical indicators or combinations appear most useful for improving entry and exit decisions?

Objectives:

- Understand how indicators work mathematically.
- Implement trading strategies using real market data.
- Evaluate performance using financial metrics



TYPES OF TECHNICAL INDICATORS

1. Trend Indicators	2. Momentum Indicators	3. Volatility Indicators
Detects long-term market direction ○ Purpose: ▪ Smooth noisy price data ▪ Identify long-term trends	Measures speed of price movement ○ Purpose: ▪ Detect overbought or oversold conditions	Measures price dispersion ○ Purpose: ▪ Identify when prices move far from average levels

INDICATORS

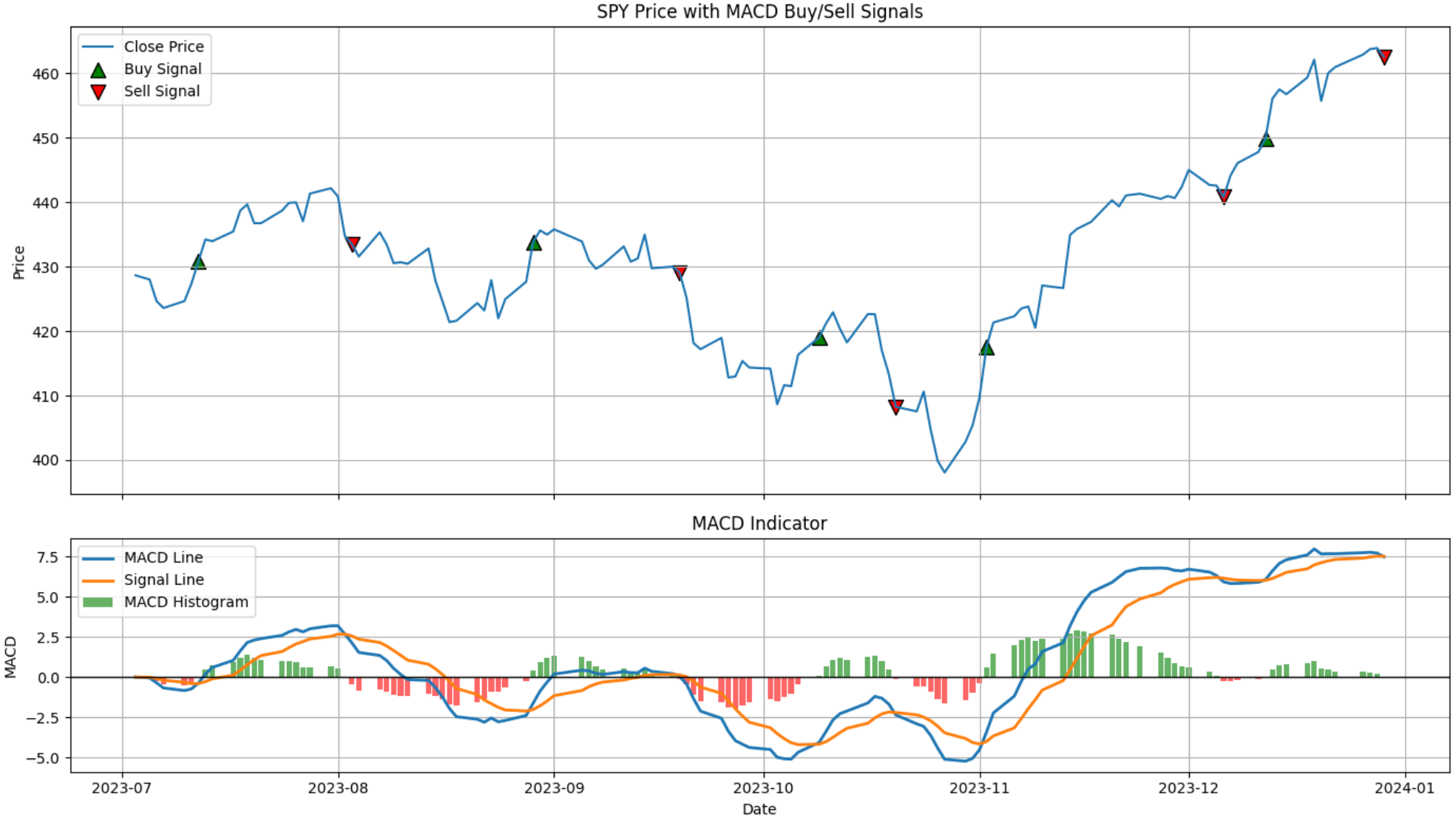
MOVING AVERAGE CONVERGENCE DIVERGENCE (MACD)

- Momentum or lagging indicator; helps traders identify changes in momentum, trend, and reversals.
- Difference between two exponential moving averages

$$MACD = EMA_{12}(P) - EMA_{26}(P)$$

$$Signal = EMA_{9}(MACD)$$

SPY PRICE WITH MACD BUY/SELL SIGNALS



RELATIVE STRENGTH INDEX (RSI)

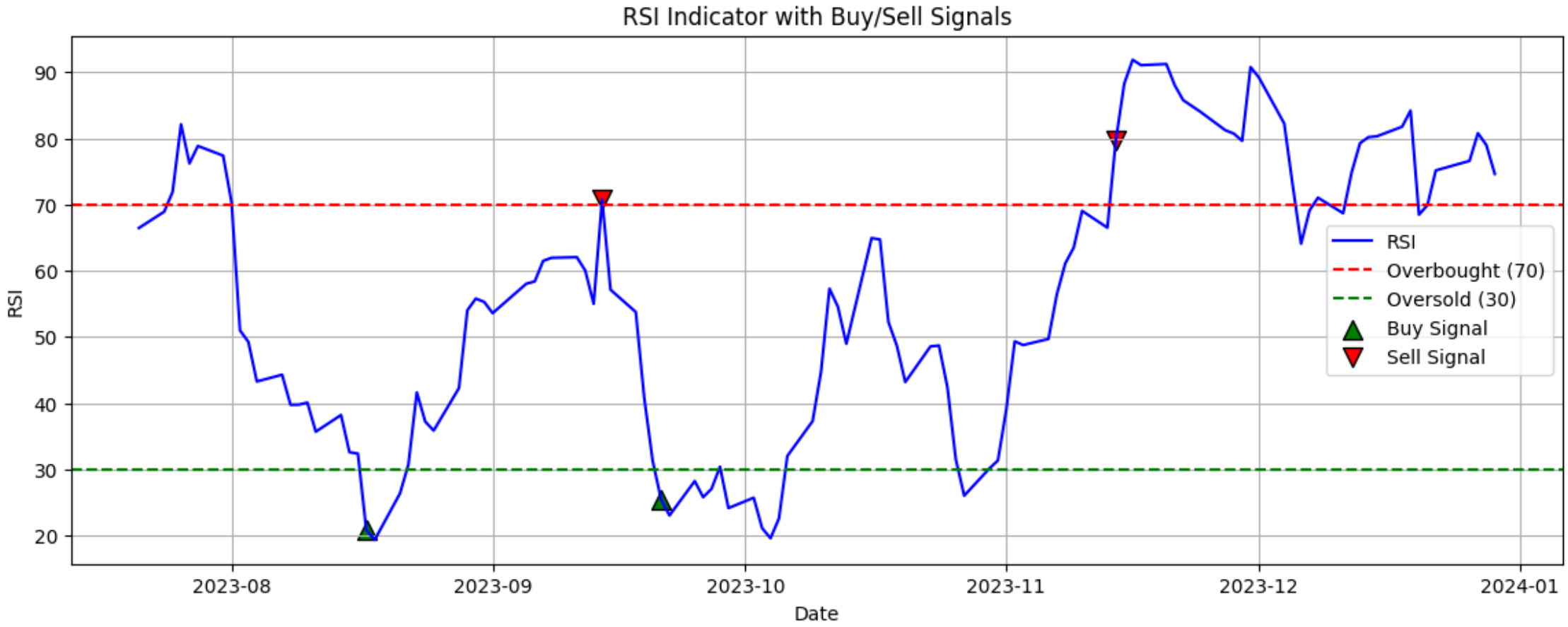
- Momentum oscillator; measures speed and change of price movements to identify overbought or oversold conditions

- Measures the ratio of average gains to average losses over a 14-day window

$$RSI = 100 - \frac{100}{1+RS}$$

$$RS = \frac{\text{Average Gain}}{\text{Average Loss}}$$

RSI INDICATOR



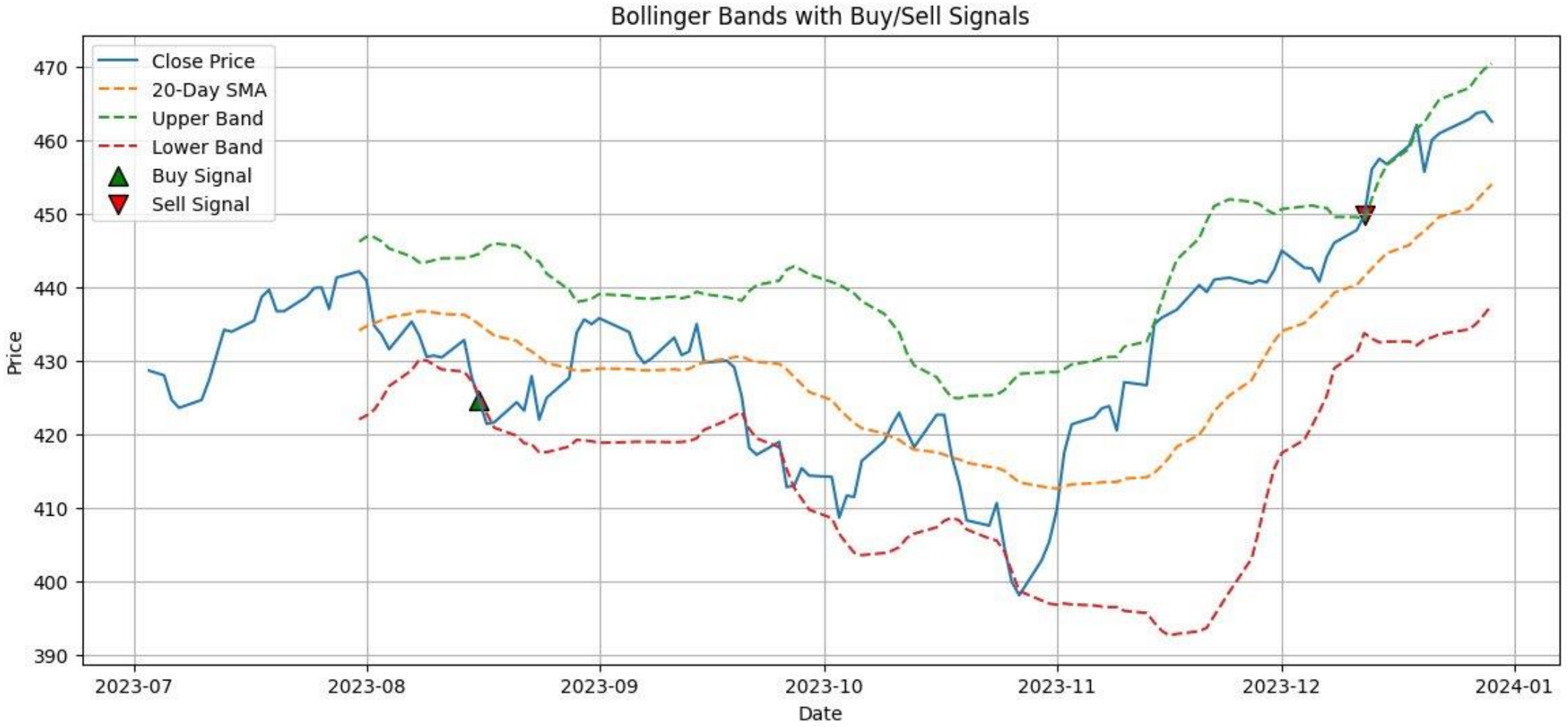
BOLLINGER BANDS

- Shows price relative to recent average; indicates volatility
- Price bands based on standard deviation
- Upper band → price is high/overbought
- Lower band → price is low/oversold

$$Upper = SMA + 2\sigma$$

$$Lower = SMA - 2\sigma$$

BOLLINGER BANDS

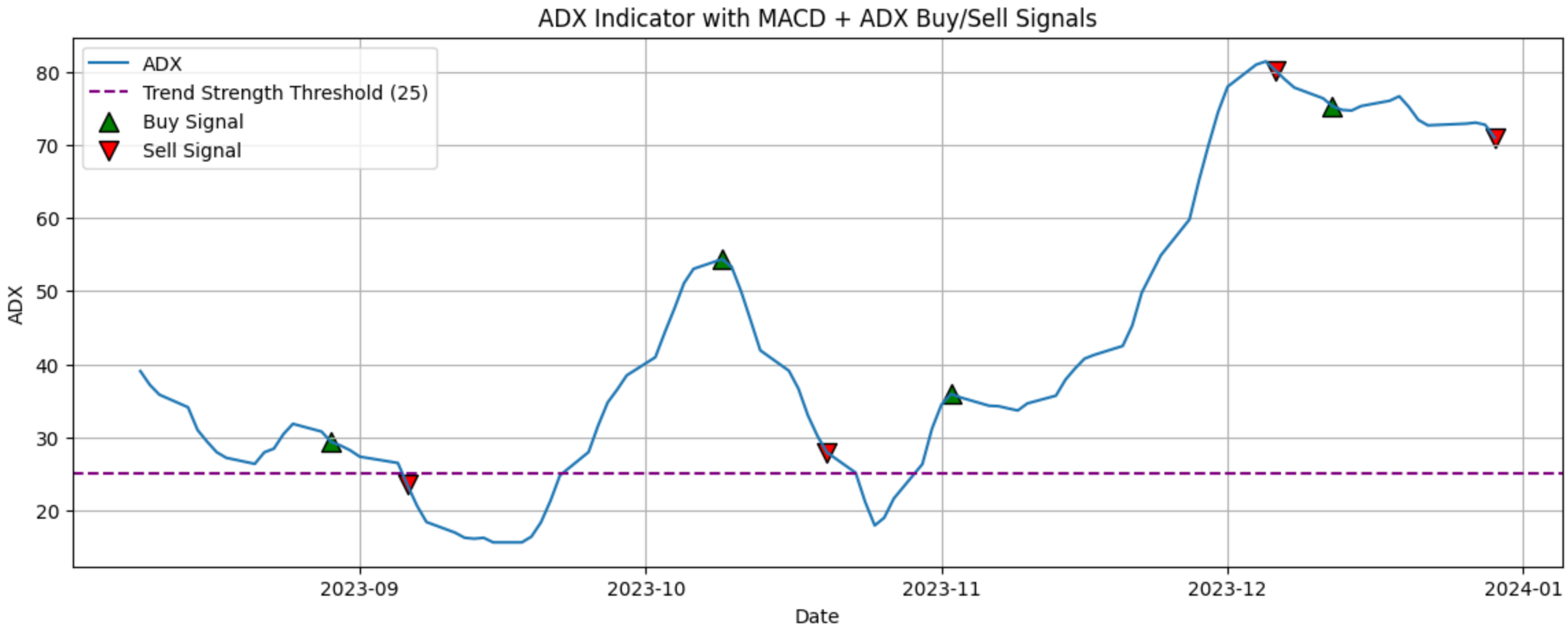


AVERAGE DIRECTIONAL INDEX (ADX)

- Measures how strong the market is trending (scale of 0–100)
- Does not tell us whether price is going up or down
- Works best paired with other indicators like MACD

- ADX < 20 → weak or sideways trend
- 20 < ADX < 25 → trend may be starting
- ADX >25 → stronger trend
- ADX > 40 → very strong trend

ADX

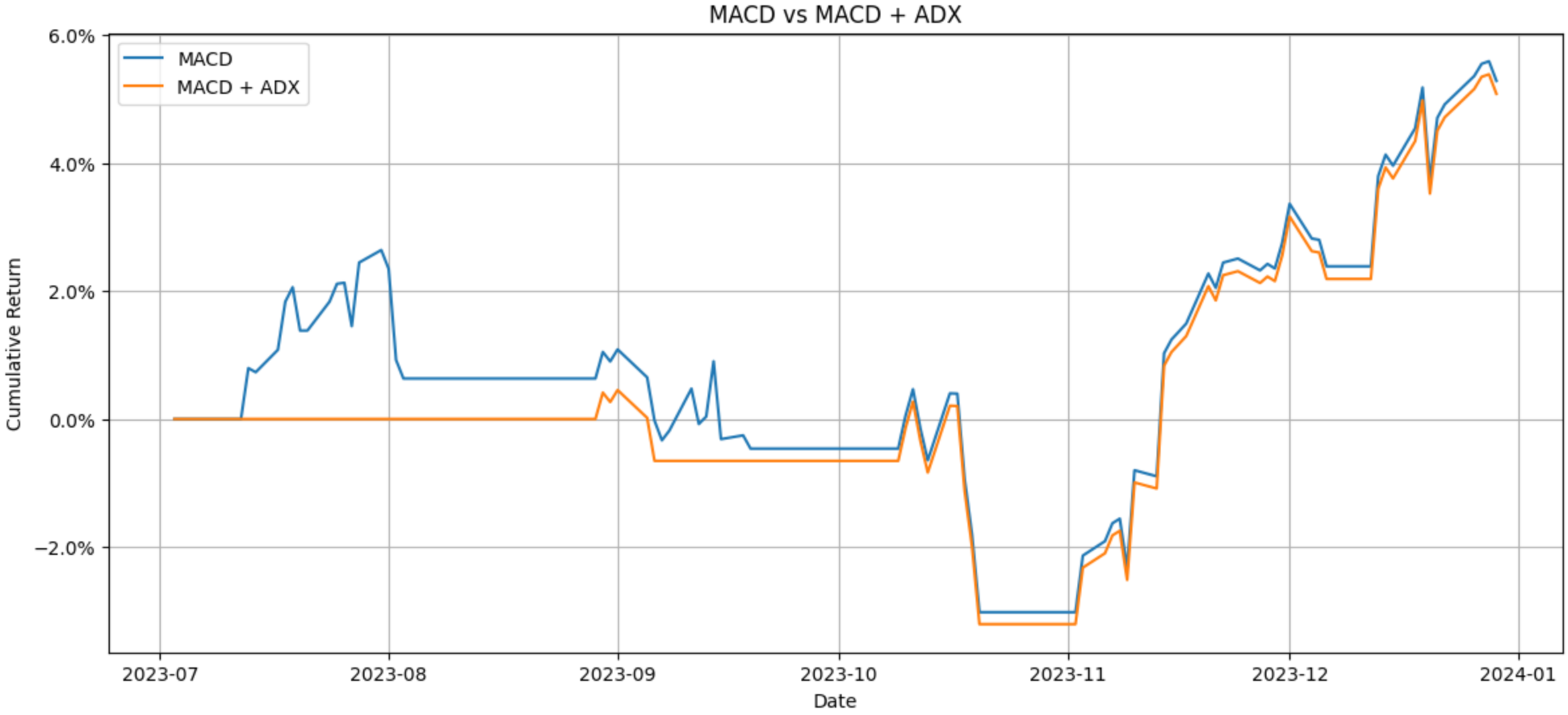

ADX Indicator with MACD + ADX Buy/Sell Signals
ADX
Trend Strength Threshold (25)
Buy Signal
Sell Signal
80
70
60
50
40
30
20
ADX
2023-09
2023-10
2023-11
2023-12
2024-01
Date

STRATEGY IMPLEMENTATION

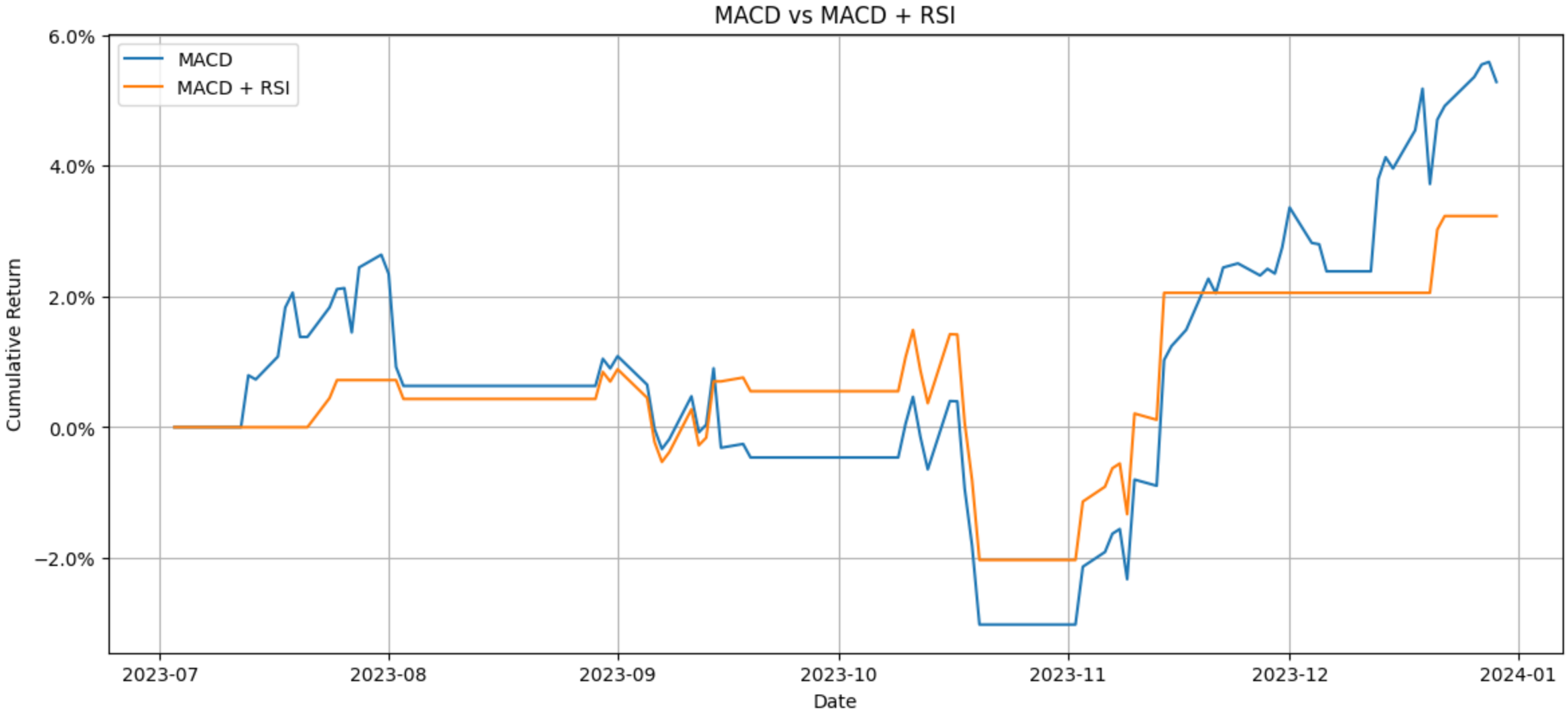
Strategy Workflow:

1. Collect price data with SPY, 1-year period
2. Tools: Python (yfinance, TA-Lib, matplotlib)
3. Approach:
    - Generate signals from each indicator
    - Test strategies
    - Compare performance across strategies

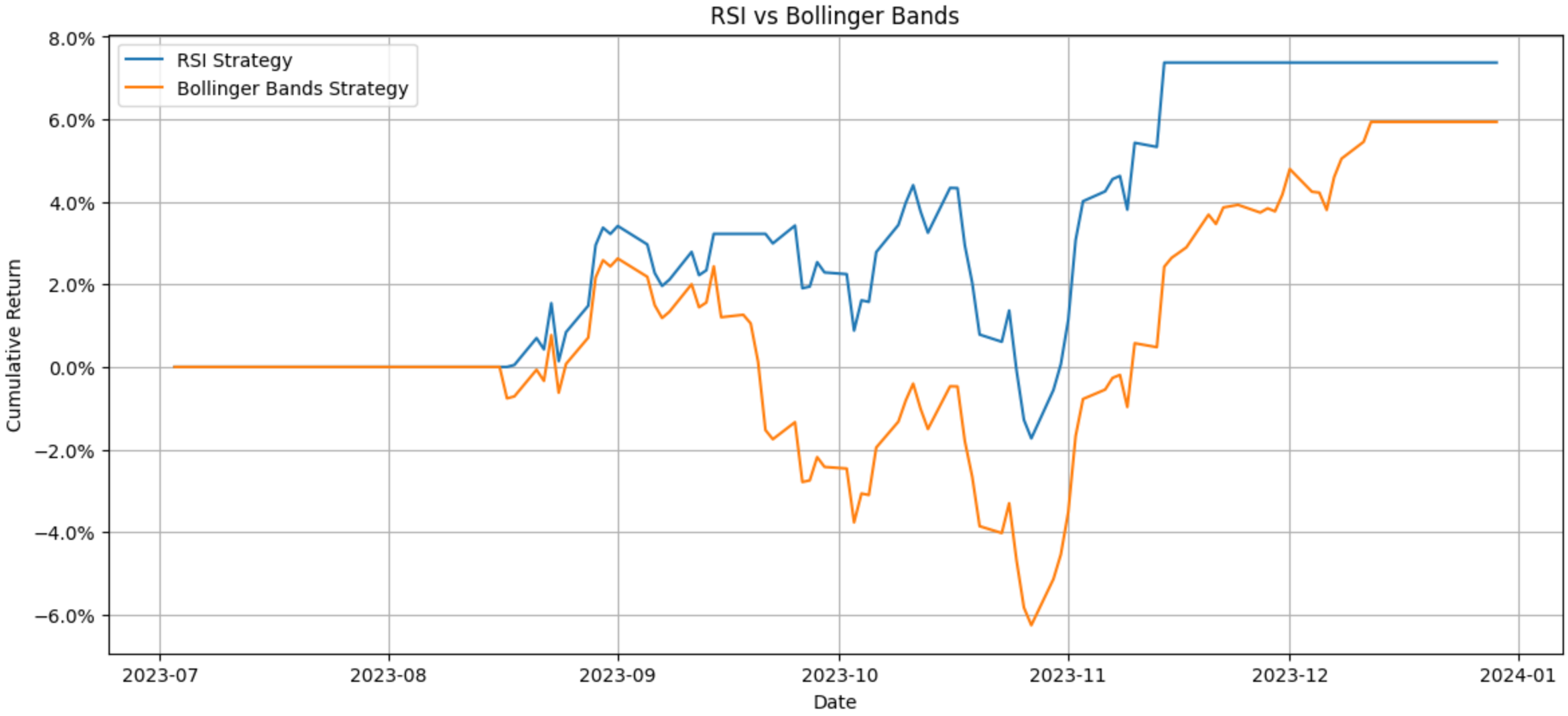
MACD VS MACD + ADX (FILTERING)



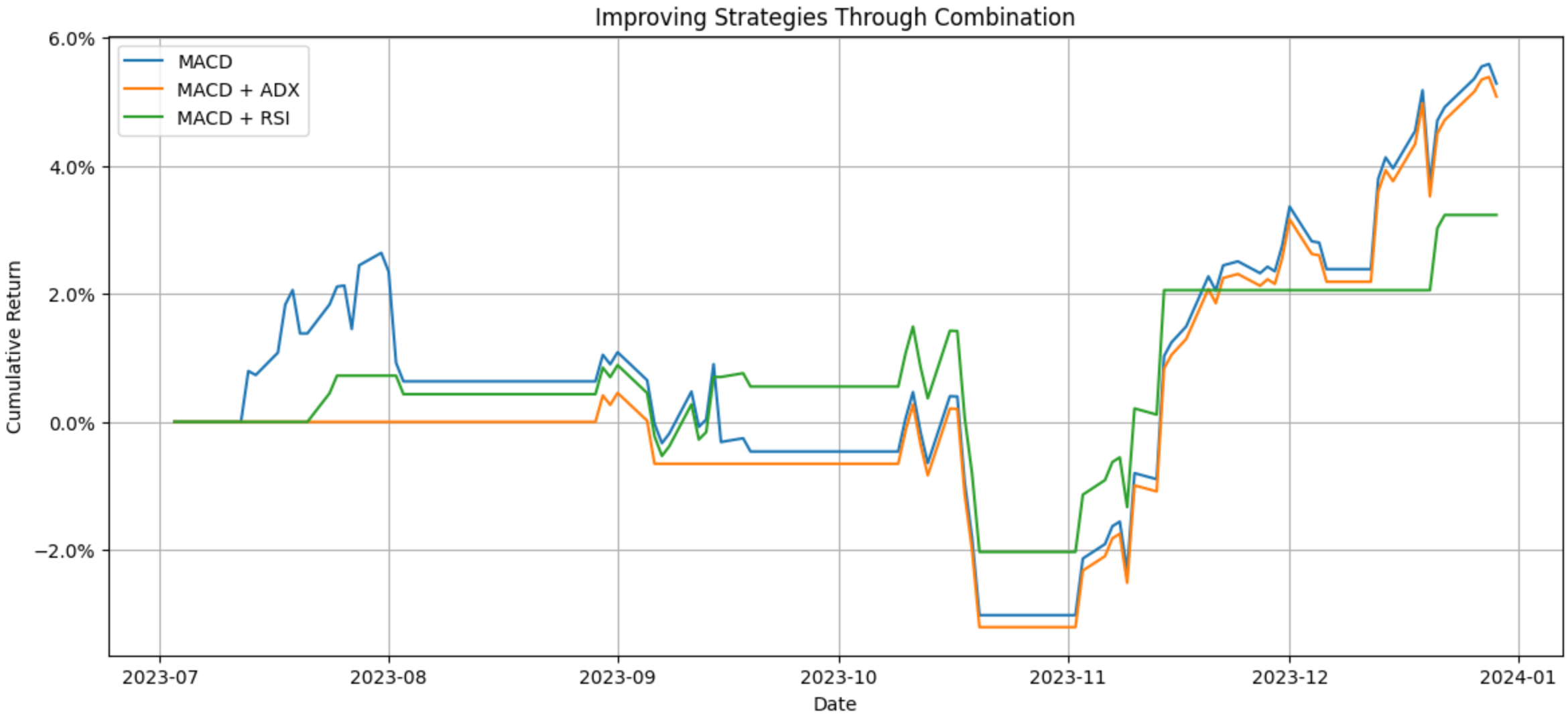
MACD VS MACD + RSI (CONFIRMATION)



RSI VS BOLLINGER BANDS



COMBINED STRATEGIES



PERFORMANCE METRICS

Sharpe Ratio:

- Measures risk-adjusted returns

$$S = \left(\frac{R_p - R_f}{\sigma_p} \right)$$

Maximum Drawdown

- Measures largest loss from peak to trough
- Formula: $(MaxPeak - MinTrough)/MaxPeak$
- Helps understand worst-case losses.

PERFORMANCE SUMMARY

Strategy	Cumulative Return (%)	Volatility (%)	Sharpe Ratio	Maximum Drawdown (%)
Buy & Hold	8%	11%	1.4	-10%
MACD	5.3%	8%	1.3	-5.5%
RSI	7%	9%	1.7	-5.9%
MACD + ADX	5.1%	6.7%	1.5	-3.6%
MACD + RSI	3%	6%	1.1	-3.4%
Bollinger Bands	5.9%	10%	1.2	-8.6%

CONCLUSION

- Combining indicators often reduce false signals and drawdowns
- Technical indicators were more useful for managing risk or improving trade timing
- There is a tradeoff between return and risk control
- Use indicator-based strategies as tools for confirmation rather than relying independently

THANK YOU FOR LISTENING