Algorithmic Trading Strategies for Exchange Rates

1. Introduction

This project examines algorithmic trading strategies for the CAD/USD exchange rate. The main goal is to compare the outcome of two trading strategies:

- Moving Average (MA) Strategy (using 5-day and 20-day moving averages)
- Relative Strength Index (RSI) Strategy (using 14-day RSI)

In this project, both strategies were tested under the same conditions:

- Transaction costs are not considered.
- Trading logic is delayed by one day.
- Each strategy starts with an initial capital of 10,000 CAD.

The performance of each strategy is compared against a benchmark portfolio which converts CAD to USD on the first day and tracks its value using daily exchange rate throughout the simulation period.

2. Data

- Source: Yahoo Finance
- Period: April 1, 2020 - March 31, 2025

3. Strategy

- **Moving Average**
  - 5-day Moving average (MA5): short-term moving average
  - 20-day Moving average (MA20): long-term moving average
  - Trading Logic:
    - Hold CAD if there is no enough data for MA5 or MA20.
    - Hold CAD / Sell CAD if MA5 > MA20.
    - Buy USD if MA5 ≤ MA20.
- **Relative Strength Index (14-day)**
  - RSI Formula:

$$RSI = 100 - \frac{100}{1+\frac{Avg.Gain}{Avg.Loss}}$$

  - Trading Logic:
    - Hold all CAD if RSI >70.
    - Gradual increase in USD position (10% → 85%) as RSI decreases from 70 to 30.

- Fully in USD if RSI <30.

This strategy uses partial entry and exit instead of all-in decisions.

4. Results and analysis

The simulation of more than 1,200 trading days compared how each strategy performed—not just in terms of profits, but also in how well they handled risk and their efficiency.

Performance Comparison

	MA Strategy	RSI Strategy	Benchmark
Final Capital (CAD)	**10546.71**	**11048.45**	**10163.02**
Total return (%)	**+5.47**	**+10.48**	**+1.63**
Max Drawdown (%)	**7.57**	**6.13**	**N/A**
Sharpe Ratio	**0.25**	**0.48**	**N/A**

- Strong Gains in Profitability

The RSI strategy generated a final profit of $1,048, nearly double that of the MA strategy ($547). Also, the RSI strategy achieved a return exceeding 10% which was more than six times the market benchmark. This shows that algorithmic trading is more reliable and effective than just holding investments without active management.

- Enhanced Risk Management

Maximum Drawdown: This measure measures the greatest decline from a peak. The RSI strategy went through a maximum drawdown of 6.31%, whereas the MA strategy had a deeper decline of 7.57%. This shows the RSI strategy has a slightly better protection against capital losses, although both strategies still experienced some ups and downs.

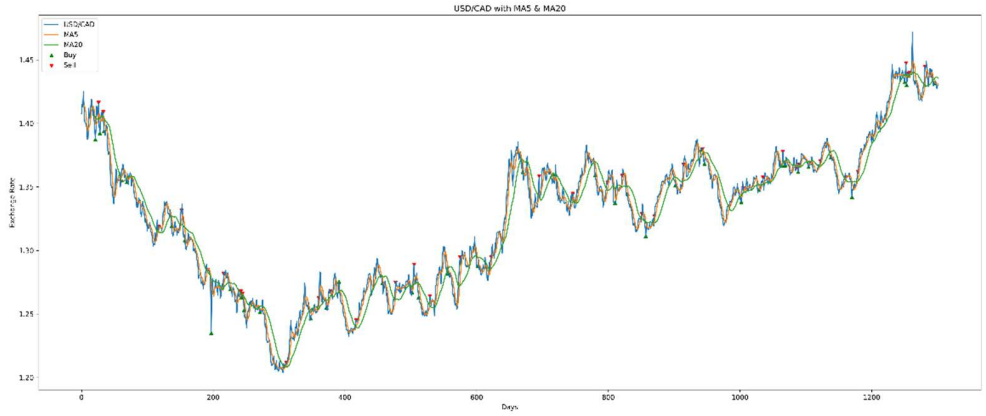
- Consistent Investment Efficiency

The Sharpe Ratio is a widely accepted measure of risk-adjusted returns. The RSI strategy achieved a ratio of 0.48, nearly double that of the MA strategy (0.25). However, both values remain relatively low, showing that both strategies are affected by occasional false signals.

Visualizations

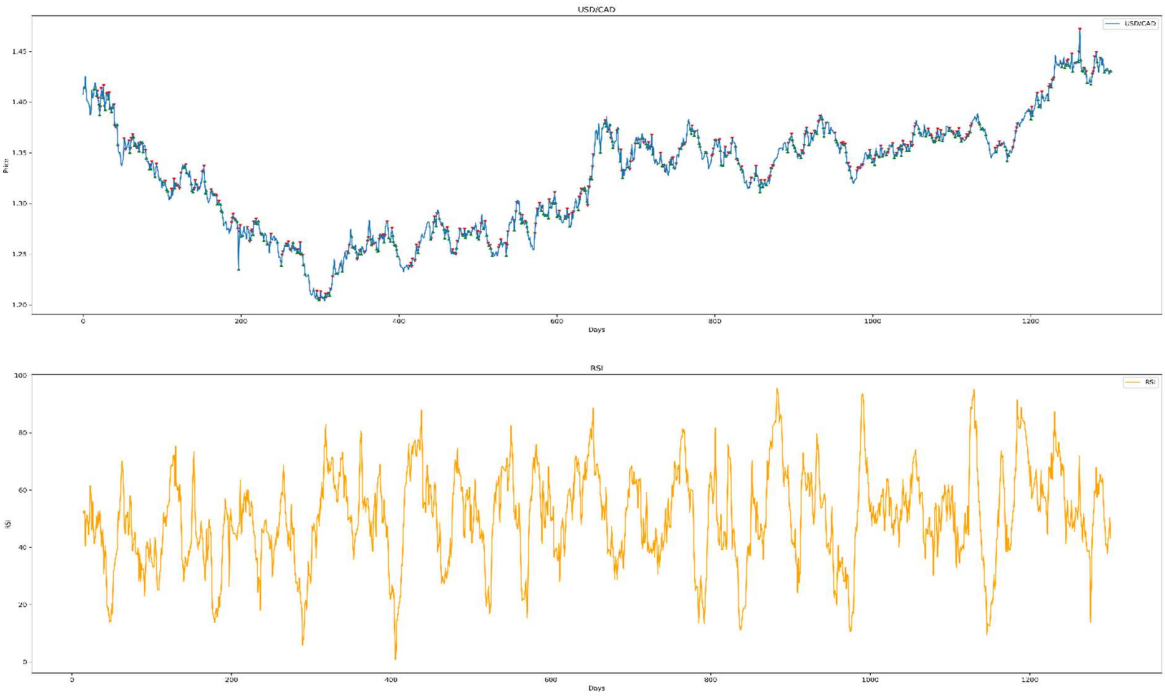
Several plots were generated to support the analysis further:

i. USD/CAD Exchange Rate with Moving Averages and Trade Signals



Explanation: This chart shows a key weakness of the MA strategy—it is easily affected by changing markets. During certain periods, especially later on, the MA strategy produced frequent false buy/sell signals, leading to a number of losses. This pattern directly explains the strategy's larger drawdowns and weaker overall profitability.

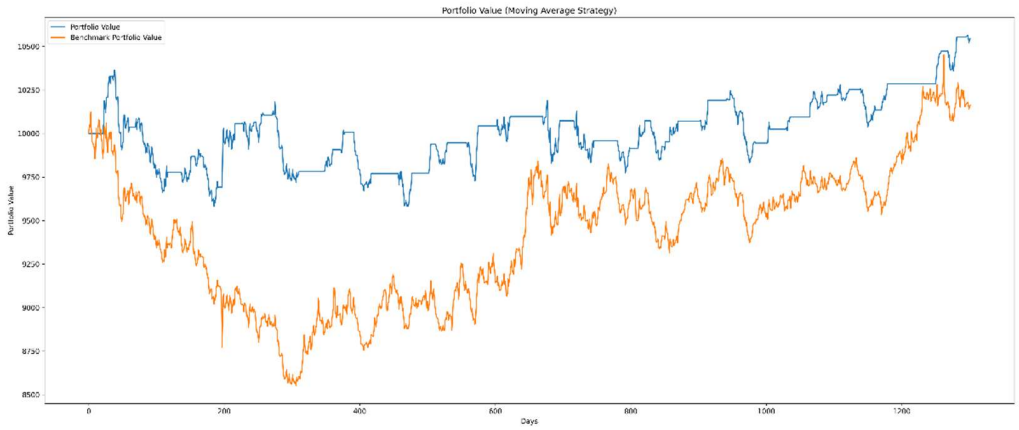
ii. RSI Indicator and Trading Signals



Explanation: This chart shows how the buy/sell signals are triggered according to the value of RSI.

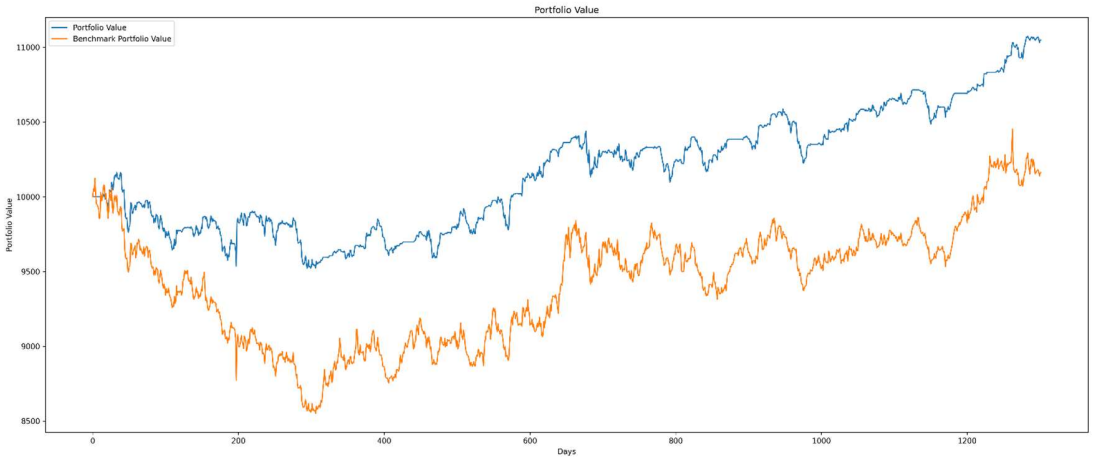
The indicator consistently identified oversold conditions (RSI < 30) and overbought conditions (RSI > 75) which makes it more effectively capturing opportunities to “buy low and sell high” than the MA strategy.

iii. Moving Average Strategy – Portfolio vs. Benchmark



Explanation: The equity curve of the MA strategy is quite unstable, with frequent ups and downs. This shows that this strategy is very sensitive to the market and it often produces false signals, especially when the market moves back and forth.

iv. RSI Strategy – Portfolio vs. Benchmark



Explanation: The equity curve of the RSI has a relatively steady upward trend with less fluctuations. This steady growth helped the capital grow smoothly. There are not many big drops, which means it kept losses small. It makes money more regularly and does not get tricked into bad trades as

often.

5. Conclusion

The project shows the potential of algorithmic trading strategies by combining mathematics with computer programming. In particular, the RSI strategy performed more consistent and better, giving both higher returns and lower risk. Furthermore, this project demonstrates that using math and smart algorithms can help solve financial problems. Overall, the results show that using algorithmic trading strategies can be more effective than simply holding investments, and they offer a good starting point for exploring more algorithmic approaches.