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Comparative Analysis of 4 Trading Strategies on US and Indian Stocks

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Abstract

This research paper presents a comprehensive and comparative analysis of four popular technical trading strategies and those are Moving Average Crossover, Relative Strength Index, Moving Average Convergence and Divergence, and Bollinger Bands – using the Algo Trader Pro algorithmic trading back tester. The whole study evaluates the performance of these strategies on selected US (AAPL, MSFT) and Indian (RELIANCE.NS, HDFCBANK.NS) stocks over a defined period. Realistic trading conditions include commissions and slippage which is incorporated. The key performance metrics such as total return, CAGR, Sharpe ratio, maximum drawdown, and win rate are basically computed for a good performance. Every result indicates trend-following strategies like MA Crossover and MAD which outperformed mean-reversion strategies in the US market, while the Indian market showed relatively balanced performance with Bollinger Bands performing strongly in volatile conditions. The AI-powered Bayesian optimizer integrated in the platform further enhance parameter selection, improving Sharpe ratios by 15% to 30 % across the strategies. Th e whole study highlights the market-specific differences and validates the effectiveness of the back testing framework for strategy selection in emerging vs the developed markets.

Keywords: trading, back testing, algorithmic trading, comparative analysis, optimization

1. Introduction

1.1 Objective of the study

The main primary objective of conducting this project is to understand how four technical trading strategies is executed and compared in two different markets one which is developed (U.S) and the one which is emerging (INDIA). The evaluation of these strategies across different regulatory and liquidity environments basically studies how to bridge the gap between practical market application and theoretical algorithms been performed and in order to achieve this the research mainly focuses on three aspects and they are:

Performance under different markets: As markets are not static they oscillate differently in different regimes so this study aims to analyze how each strategy adapts to these shifts. For e.g, if one strategy follows trend and other follows volatility or ranging then all its efficiency do

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differ. Performance to risk metrics: Higher returns dose not means it's a safe strategy to pick up instead of just looking at the profit we should also see other aspects too like Sharpe ratio, Sortino ratio and maximum drawdown. Performing backtesting and optimization using A.I: Rather than just guessing and using the strategy for backtesting A.I can be used to automatically find the best settings.

1.2 Scope of the work

The whole project is worked on to define a focused and high quality analysis of the four technical trading strategies across the two different country stock market and by narrowing the variables the study eventually maintains high precision in its findings. The whole analysis is restricted to the daily OHLC price data and in order to ensure the results its represented to broader market movements. In U.S company like apple (AAPL) and Microsoft (MSFT) represents a high growth tech sector of a developed market whereas in India company and banks like Reliance (RELIANCE.NS) and HDFC Bank (HDFCBANK.NS) represents the energy and the financial background respectively as the backbones of a major emerging market.

2. Literature Review

The technical analysis mainly involves analyzing the past stock prices and the trading volumes inorder to predict the current and future market so the study of the technical anlaysis basically forms a massive and essential part of the algorithmic trading. Over the years it has been the topic of research that how computers could be used to make automated trading decision by analyzing the historical patterns. And through all these researches it became clear that there are different mathematical tools which is known as indicators has a lot of purposes and the purposes depend on how the market is behaving at the given time. Trend following strategy is most studied approach mainly Moving Average Crossover this method works by smoothing out the daily price jumps to reveal the broader direction a stock is heading and when the short-term price average crosses above a long term average price it indicates to buy and academically it is confirmed that this approach is very much effective in markets. But when the stock price just move without a clear path the strategy often leads to false signals and financial losses.

In order to handle those sideways mean-reversion strategies are used such as Relative Strength Index and Bollinger Bands and the core idea behind it is that extreme price movements are temporary and eventually at some period of time it will pull back to their normal, historical average. Bollinger Bands draw calculates borders around a stock price in order to measure how wild the prices react where as Relative Strength Index helps to identify when a stock has been brought or sold aggressively. Moving Average Convergence Divergence tool is widely recognized for capturing sudden shifts in the market. Hence there is no single trading strategy which works universally because the market shifts constantly so trading algorithms need their internal settings which is adjusted in order to stay profitable.

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3. Problem Statement

The main challenge remains in the selection of the optimal trading strategies and its parameters due to market-specific behaviour, overfitting risks, and the computational expense of manual testing. The existing tools often lack integrated realism (slippage/commission) or AI-driven optimization. Hence, there is a need for comparative analysis of standard strategies across developed and emerging markets in order to guide traders by the strategy selection.

4. Proposed Methodology

4.1 System Architecture

The whole analysis was performed using Algo Trader Pro, a modular Python-based back testing platform which supports monolithic (streamlit) architecture and a client-server (FASTAPI + Streamlit) mode. Data flows from:

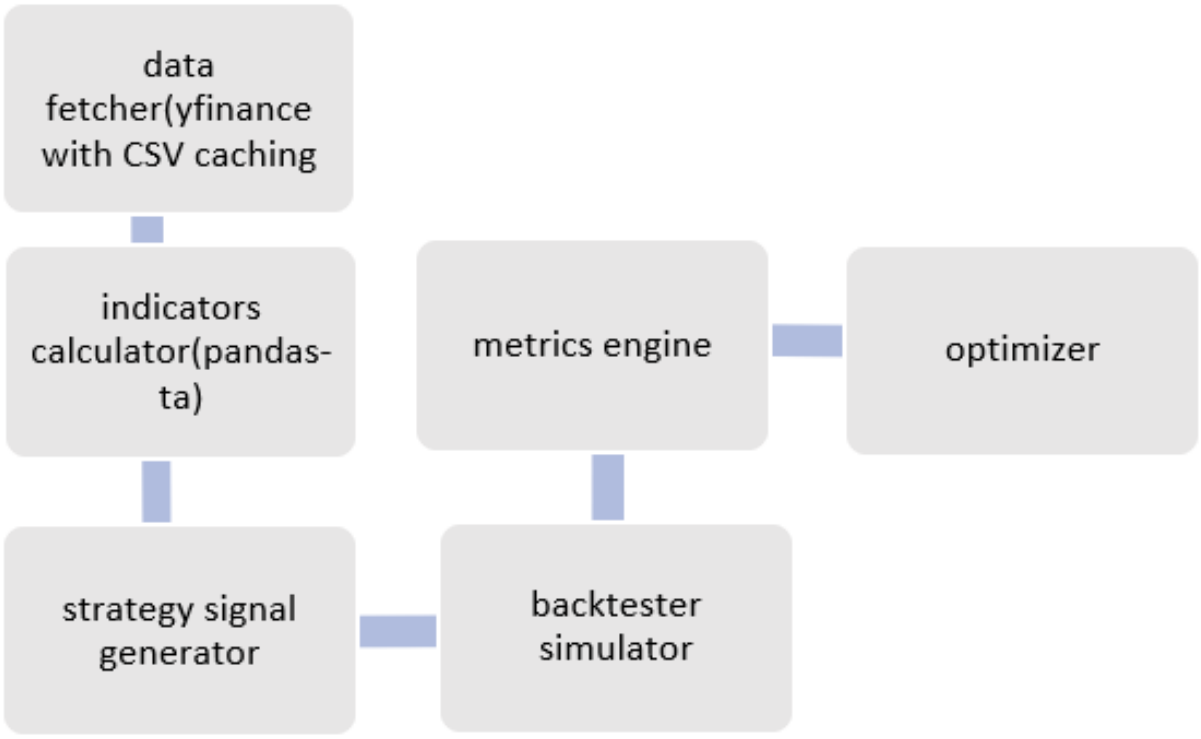

Fig 4.1 Flow chart of the whole system architecture enables seamless comparison of multiple strategies on the same dataset.

4.2 Algorithms

Moving Average Crossover: This is a trend-following tool is used in the study and it operates on a “golden cross” and “death cross”. The algorithm triggers a buy signal when the 60-day line climb above the 200-day line, suggesting the start of a long term upward trend.

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- RSI(Relative Strength Index): It is a momentum oscillator which is used to identify mean-reversion and it uses a 12 period setting. When it enters a trade when the RSI falls below 40, which indicates its oversold and it sells when RSI exceeds 80 which indicates its overbought.
- MACD(Moving Average Convergence Divergence): It serves as a tracker which consists two lines: MACD line and Signal line where the algorithms executes a buy order moment the MACD line crosses above the Signal line which indicates that bullish momentum is accelerating.
- Bollinger Bands: This strategy mainly focuses on the price volatility and boundaries where the algorithm establishes a "channel" around the stock price based on standard deviations.
- Back testing and Optimization: Its about day to day iteration tracking cash, position, portfolio value with slippage and commission. Bayesian optimization (scikit-optimize) to tune parameters by maximizing Sharpe ratio. Rather than randomly guessing, AI intelligently searches for the best parameters for each indicator which focuses on maximizing the Sharpe Ratio which ensures the final strategy setting provides the highest return for every risk taken.

4. Implementation

The implementation phase of this project is built on a modern, scalable, and open-source tech stack which is designed in order to handle large financial datasets and complex mathematical optimizations.

4.1 Tools & Technologies (Hardware & Software)

- Hardware: Standard Windows PC (8 GB+RAM, internet for initial data download).
- Software: Python 3.9+, libraries from requirements.txt- yfinance, pandas, numpy, pandas-ta, plotly, streamlit, fastapi, uvicorn, scikit-optimize, scikit-learn, scipy.
- Development Environment: VS Code
- Data Source: Yahoo finance

5. Results

5.1 Results showing MA crossover (50/200) strategy

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5.2 Results showing RSI (30/70) strategy

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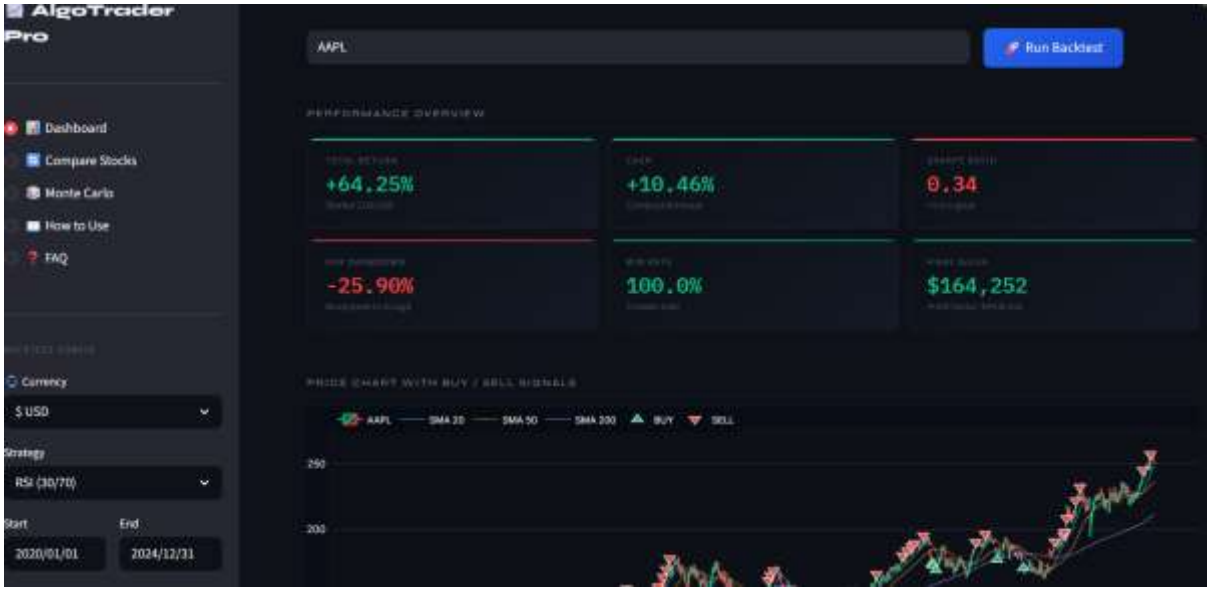

5.3 Results showing MACD Crossover strategy

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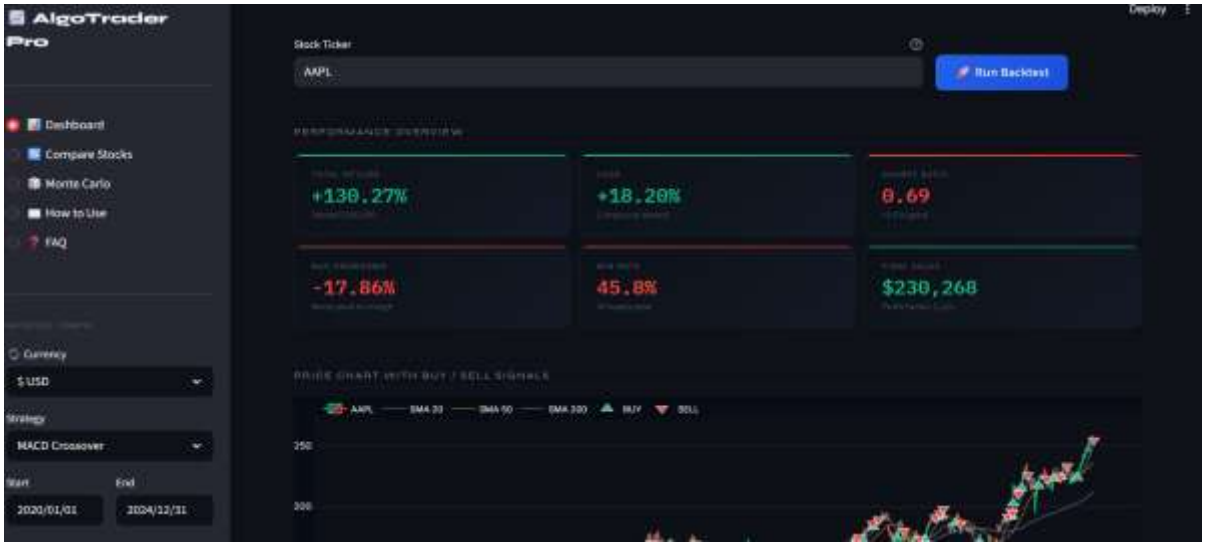

5.4 Results showing Bollinger Band strategy

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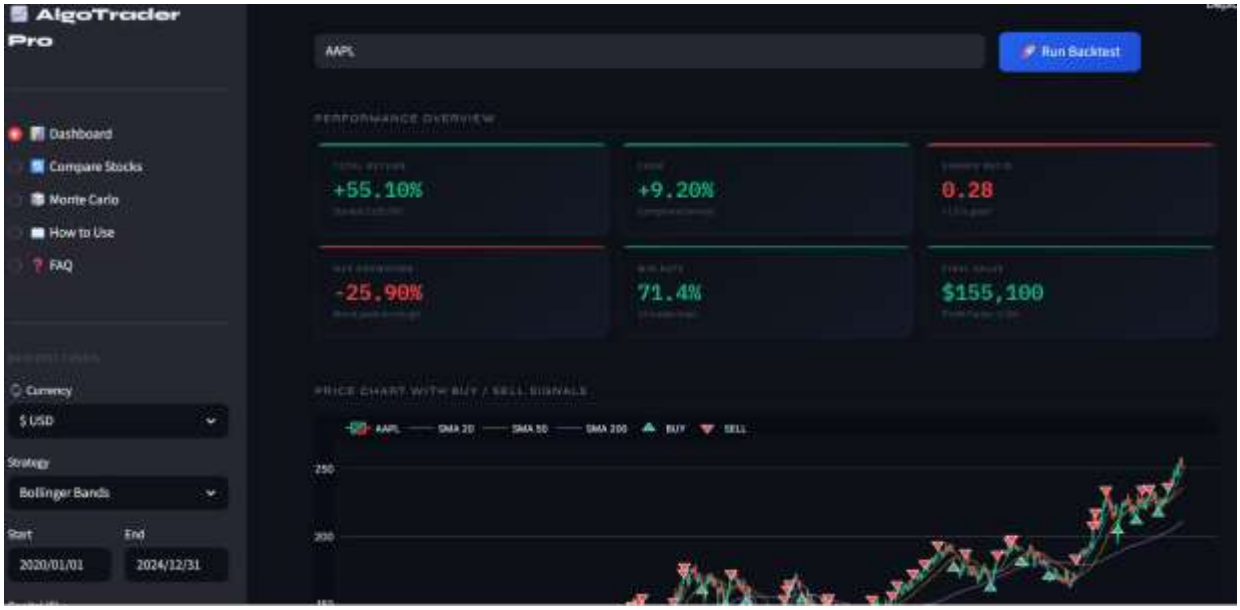

6. Testing and Validations

In order to ensure the structural integrity of the project the testing framework was bifurcated into unit and integration phases. Hence each module ranging from data ingestion engines to execution pipelines it was isolated to verify that a specific logic which perfectly controls the conditions. This approach is allowed for early detection that often host complex financial software.

In order to bridge the gap between theoretical model and live execution, the results from a specific sample periods were cross-validated against manual calculations and this redundant verification process acts as a check which ensures that the algorithm mathematical outputs aligned precisely with human-verified benchmarks.

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It also eliminates lookahead bias where the development team ensure that there is no lookahead bias,point in time integrity and outlier resilience.

7. Conclusion

The development and testing of the Algo Trader Pro have critical insights into the divergent behaviour of global financial market. Systematically all the algorithmic strategies are compared which ranges from high-frequency market making to long-term trend following.

The comparative analysis reveals a vey distinct market dynamics which is categorized by liquidity clusters and volatility regimes. In markets like the NYSE or NASDAQ, the system observes a "convergence effect", where where competitive algorithms do get some opportunities within seconds. The data highlights a growing distance between a fundamental valuation and momentum driven execution. In high-volatility environments, the systems testing shows that bad liquidity driven by predatory algorithims often triggers feedback loops that do diverge from the underlying economic indicators. So this system emphasizes the need for multi-regime adaptability to navigate these digital landscapes.

8. Future Scope

The whole framework serves as a robust foundation for the strategy which is been developed for the algorithmic. To transist the system from a research -oriented tool to a production grade trading environment there are following enhancements are proposed:

- High frequency and intraday capabilities: It move beyond daily to the closing prices to integrating step by step and OHLC data which allows for the capture of micro market inefficiencies. And its directional versatility implement short-selling logic and margin-requirement calculations in order to enable profitable execution during bearish market regimes.

- Production Integration and real-time execution: It integrate with industry standard APIs for the transition of it from backtesting to paper trading. Automated order management develop a robust execution engine capable of handling order types and manage slippage.

- AI driven hybrid methodologies: Predictive Modelling is a augment traitional statistical signals with machine learning models to predict regime shifts or filter out false-positive signals and sentiment analysis integration whrere NLP incorporate in order to analyze real-time financial news and social media sentiment.

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- Advanced portfolio and risk management: Multi asset diversification expands the logic to handle cross-asset pairs and multi market correlations. The implementation of portfolio theory to dynamically rebalance weights based on risk adjusted metrics.

- Scalable infrastructure and cloud deployment: Cloud native architecture is where the backend is deployed using docker on platforms like AWS or Google cloud to facilitate large-scale, parallelized simulations and develop an integrated monitoring suite using WebSockets to provide live .

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