Task 2: Feature Engineering and Machine Learning-Based Trading Strategy Report

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1 Introduction

This report summarizes the development and backtesting of the *Alpha3 Strategy*, which is based on Alpha #3 from the "101 Formulaic Alphas". The strategy focuses on detecting market inefficiencies by analyzing the ranked correlation between stock open prices and volumes over a certain lookback period. The strategy was tested on Indian stocks, and this report presents its performance analysis, findings, and recommendations for improvement.

2 Alpha3 Formula and Strategy Overview

The *Alpha3 Strategy* is based on the following formula from the 101 Formulaic Alphas:

$$\text{Alpha \#3: } (-1) \times \text{correlation}(\text{rank}(\text{open}), \text{rank}(\text{volume}), 10)$$

This formula captures the correlation between ranked open prices and trading volumes over a 10-period lookback. The strategy generates buy and sell signals based on the following conditions:

- **Buy Signal:** Strong negative correlation between open prices and volumes, i.e., when the correlation is below -0.5.
- **Sell Signal:** Weak or positive correlation, i.e., when the correlation is above 0.5.

3 Backtesting Methodology

The strategy was backtested on a diverse universe of Indian stocks. Data from various sectors, including large-cap and mid-cap stocks, was used. The following key components were considered during backtesting:

- **Transaction costs:** A commission of 0.1% was applied to simulate real-world trading conditions.
- **Slippage:** A slippage rate of 0.1% was included to account for the difference between expected and actual trade prices.
- **Initial capital:** The initial portfolio capital was set to $1,000,000.

The backtest was run on 1-hour time interval stock data to simulate intraday trading.

4 Backtesting Results

4.1 Performance Metrics

The key performance metrics for the *Alpha3 Strategy* are as follows:

- **Starting Portfolio Value:** $1,000,000.00
- **Ending Portfolio Value:** $999,891.45
- **Total Return:** -0.01%
- **Sharpe Ratio:** 0.02
- **Sortino Ratio:** 0.90
- **Maximum Drawdown:** 187.04%
- **Trade Frequency:** 235 trades
- **Hit Ratio (Winning Trades Percentage):** 45.11%

4.2 Analysis of Results

Total Return and Portfolio Value: The strategy yielded a small negative return of -0.01%, resulting in a slight reduction in the portfolio value by the end of the backtest. The result indicates that the Alpha3 strategy was not profitable over the given backtest period, largely due to high volatility and drawdowns.

Risk Metrics: The strategy's Sharpe Ratio was 0.02, indicating a low risk-adjusted return. A Sortino Ratio of 0.90 suggests that, although the strategy experienced several profitable trades, the downside risk was significant. The Maximum Drawdown of 187.04% reflects the strategy's vulnerability to large losses during unfavorable market conditions.

Trade Frequency and Hit Ratio: The strategy executed 235 trades during the backtest period, reflecting an active trading approach. However, the hit ratio of 45.11% indicates that less than half of the trades were profitable.

5 Discussion

5.1 Strengths

- The strategy leverages an interesting approach by using ranked correlation between open prices and volumes to generate trading signals.
- With proper modifications and optimization, the strategy can potentially capture short-term market inefficiencies.

5.2 Weaknesses

- The high maximum drawdown reveals that the strategy is exposed to significant risk during adverse market conditions.
- The low Sharpe Ratio suggests that the strategy's risk-adjusted return is not attractive.
- A hit ratio of 45.11% implies that the strategy's win rate is below 50%, which is insufficient to offset trading costs and slippage.

6 Recommendations

To improve the performance and robustness of the Alpha3 strategy, the following adjustments are recommended:

- **Enhanced Risk Management:** Implement additional risk management techniques such as stop-loss and take-profit levels to reduce the maximum drawdown.
- **Signal Optimization:** Experiment with alternative ranking methods and different lookback periods to enhance signal quality.
- **Diversification:** Backtest the strategy on a broader universe of stocks, including international markets, to assess performance across different market environments.
- **Feature Engineering:** Incorporate additional market factors such as volatility or momentum to refine the alpha signal.

7 Conclusion

The Alpha3 strategy presents an innovative approach to generating trading signals based on the correlation between ranked open prices and volumes. However, the backtesting results indicate significant room for improvement, particularly in risk management and signal optimization. Future work should focus on refining the alpha signal and enhancing the strategy's ability to perform in varying market conditions.