Algorithmic Trading Strategies Report

Introduction

The purpose of this study is to develop algorithmic trading strategies to optimize returns and manage risk efficiently in the context of stock trading. This report provides a comprehensive analysis of three algorithmic trading strategies applied to the stock ticker symbol 'PENN' (Penn National Gaming, Inc.) (A volatile stock that I wanted to see how my strategies would perform under such conditions). The strategies evaluated include Simple Moving Average (SMA), Relative Strength Index (RSI), and Bollinger Bands.

Data and Time Period

The analysis encompasses historical data for the 'PENN' stock prices from January 2020 to February 2024, sourced from Yahoo Finance. The dataset includes daily stock prices, which are essential for calculating returns and implementing algorithmic trading strategies. Additionally, when back testing, a $5 trade expense per transaction was considered, along with a 2% annual management fee, like what is typically observed in personal investments.

Methodology

The three algorithmic trading strategies evaluated in this study are the Simple Moving Average (SMA), Relative Strength Index (RSI), and Bollinger Bands. The methodologies for each strategy are detailed below:

Simple Moving Average (SMA): This strategy calculates the average price of the stock over a specified time window (e.g., 50 days) and generates buy signals when the current price crosses above the moving average and sell signals when it crosses below.

Relative Strength Index (RSI): The RSI strategy measures the magnitude of recent price changes to evaluate overbought or oversold conditions. Buy signals are generated when the RSI falls below a certain threshold (e.g., 30), indicating oversold conditions, while sell signals occur when the RSI exceeds another threshold (e.g., 70), indicating overbought conditions.

Bollinger Bands: This strategy utilizes volatility measures to identify potential buy and sell opportunities. Bollinger Bands consist of a simple moving average (SMA) and upper and lower bands representing standard deviations from the SMA. Buy signals are generated when the stock price touches or falls below the lower band, indicating oversold conditions, while sell signals occur when the price touches or rises above the upper band, indicating overbought conditions.

Empirical Results

Simple Moving Average (SMA) Strategy: The SMA strategy exhibits an average decision time of 0.0 seconds. It yields a cumulative return of 32.5% over the specified time. Monthly returns fluctuate, with notable positive returns in certain months. The strategy's maximum drawdown stands at -36.48%, with an average portfolio turnover of 0.87%. While the returns are not significantly different from 0 (p-value: 0.349), the strategy outperforms a Buy-and-Hold approach both in a frictionless market and with expenses accounted for.

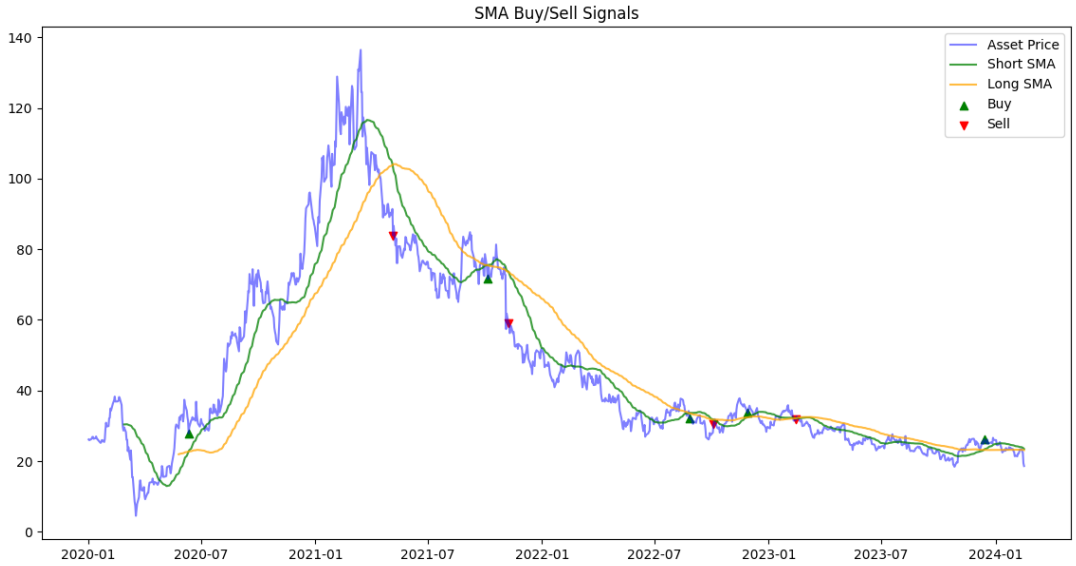
Relative Strength Index (RSI) Strategy: The RSI strategy demonstrates an average decision time of 0.000006 seconds. It generates a cumulative return of 24.09% throughout the evaluation period. Monthly returns vary, with some months showing substantial gains. The maximum drawdown for this strategy is -28.59%, with an average portfolio turnover of 0.14. While returns are not statistically

significant (p-value: 0.398), the RSI strategy outperforms a Buy-and-Hold strategy in both frictionless and fee-inclusive scenarios.

Bollinger Bands Strategy: The Bollinger Bands strategy exhibits an average decision time of 4.310456 seconds. It delivers a cumulative return of 37.77% over the analysis period. Monthly returns fluctuate, showcasing volatility in performance. The strategy experiences a maximum drawdown of -37.77% and has an average portfolio turnover of 0.0087. However, the returns are not statistically significant, and the strategy does not outperform a Buy-and-Hold approach in either frictionless or fee-inclusive scenarios.

Conclusion

Algorithmic trading strategies offer promising avenues for enhancing investment returns and managing risk in today's volatile markets. Through rigorous back testing and analysis, investors can identify robust strategies that align with their investment objectives and risk tolerance. The insights provided in this report serve as a foundation for informed decision-making and strategic implementation of algorithmic trading strategies in live trading environments.


SMA Buy/Sell Signals
Asset Price
Short SMA
Long SMA
Buy
Sell
140
120
100
80
60
40
20
0
2020-01
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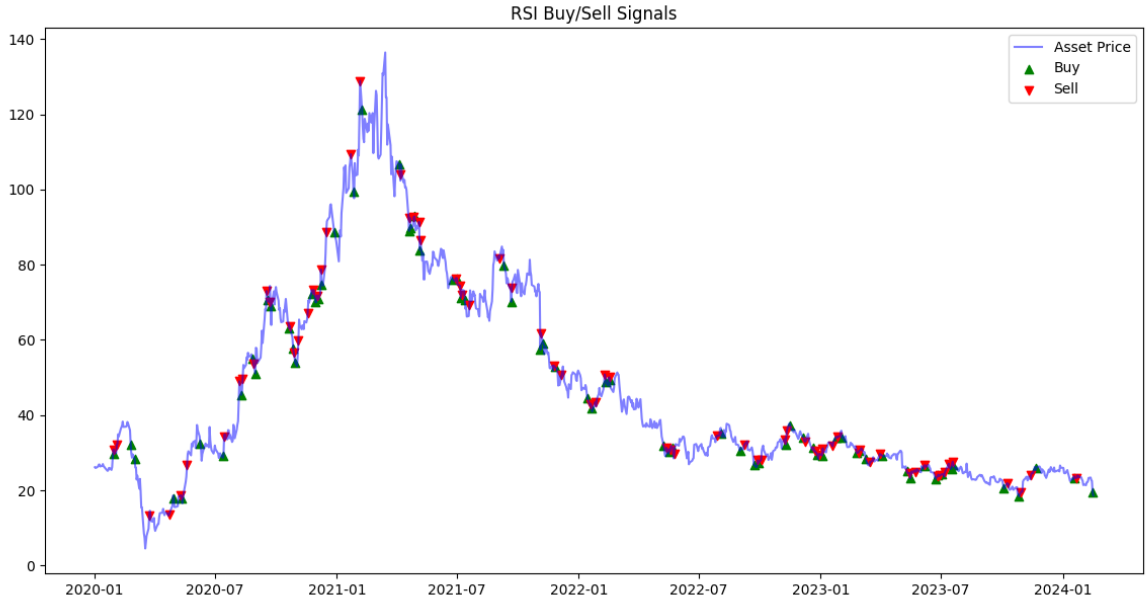
2021-01
2021-07
2022-01
2022-07
2023-01
2023-07
2024-01


RSI Buy/Sell Signals
Asset Price
Buy
Sell
140
120
100
80
60
40
20
0
2020-01
2020-07
2021-01
2021-07
2022-01
2022-07
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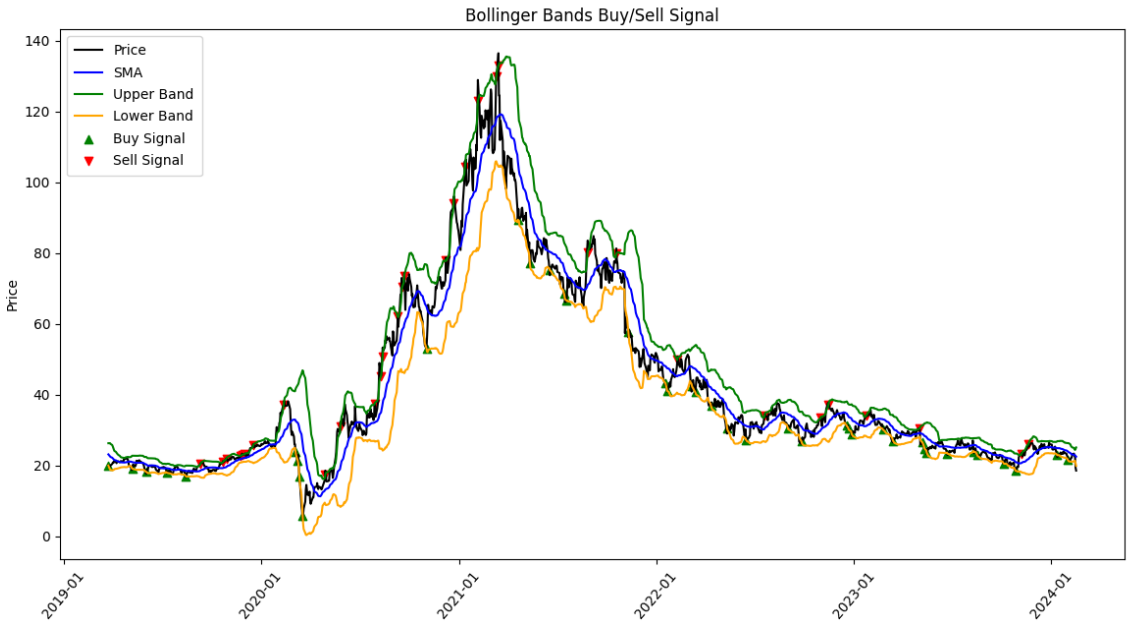
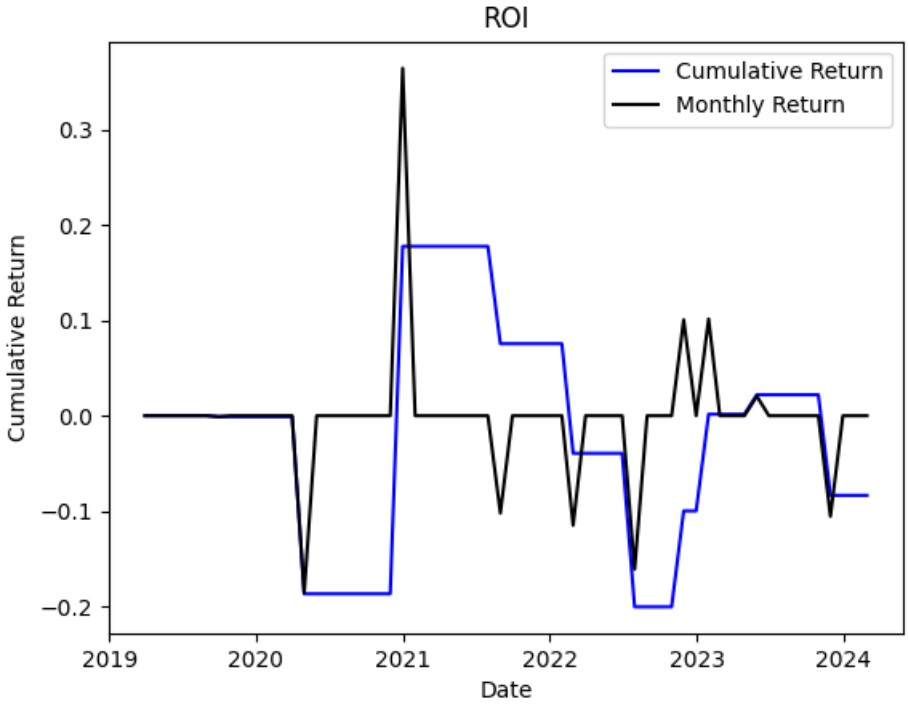

Bollinger Bands Buy/Sell Signal
Price
SMA
Upper Band
Lower Band
Buy Signal
Sell Signal
Price
140
120
100
80
60
40
20
0
2019-01
2020-01
2021-01
2022-01
2023-01
2024-01


ROI
Cumulative Return
Monthly Return
0.3
0.2
0.1
0.0
−0.1
−0.2
Cumulative Return
2019
2020
2021
2022
2023
2024
Date