

# Machine Learning Based Trading

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*This is a brief overview of the project. Due to academic integrity policies, the full code and report cannot be shared publicly. Please feel free to contact me directly for access or additional details.*

This project explores the application of machine learning techniques to develop and evaluate algorithmic trading strategies. The goal was to outperform a benchmark portfolio by leveraging advanced technical indicators and machine learning models to generate buy/sell signals. The project was implemented in Python, utilizing libraries such as NumPy, Pandas, and Matplotlib.

## Key Components

### 1. Indicators Used:

- **Price/SMA:** Quantifies the deviation of a stock's price from its simple moving average.
- **Bollinger Bands (%B):** Assesses volatility based on upper and lower bands relative to price.
- **Rate of Change (ROC):** Measures the momentum of stock prices over time.

### 2. Strategies Implemented:

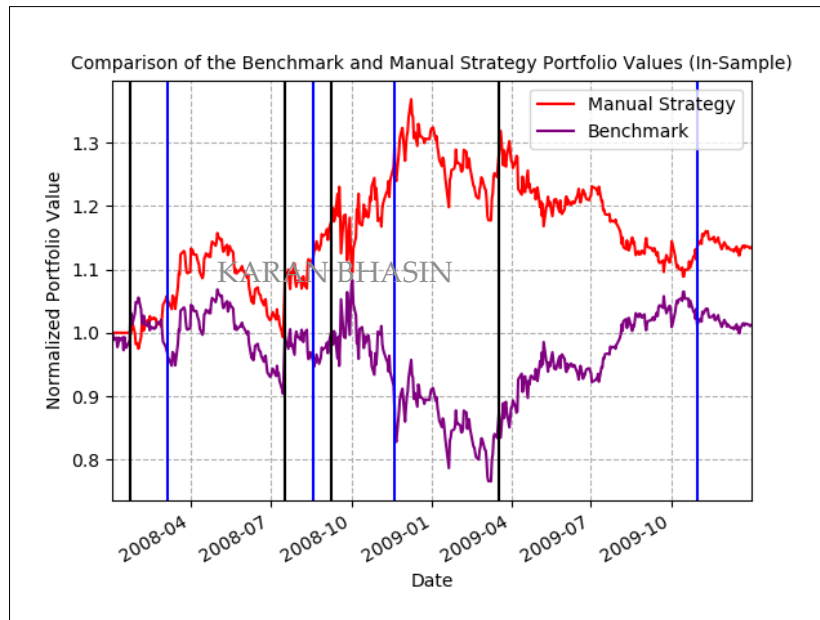
- **Manual Strategy:** Utilized fixed thresholds for indicators to generate trading signals.
- **Strategy Learner:** Implemented a classification-based machine learning approach using a **Bag Learner** with a **Random Tree Learner** as its base model to dynamically adapt to market conditions.

## Performance Evaluation

The strategies were tested on historical data for in-sample and out-of-sample periods. Results showed that both strategies consistently outperformed the benchmark portfolio in terms of cumulative returns and risk-adjusted metrics.

*Table 1* — Performance metrics of benchmark, Manual Strategy and Strategy Learner for in and out-of-sample data

Performance Metric	In-Sample			Out-of-Sample		
	Benchmark	Manual Strategy	Strategy Learner	Benchmark	Manual Strategy	Strategy Learner
Cumulative return	0.012325	0.134999	0.386126	-0.083579	0.138079	0.127023
Standard deviation of daily returns	0.017041	0.013413	0.012762	0.008500	0.007568	0.007410
Mean of daily returns	0.000169	0.000341	0.000729	-0.000137	0.000286	0.000265



*Figure 1* — Comparison of benchmark and Manual Strategy portfolio values (in-sample)

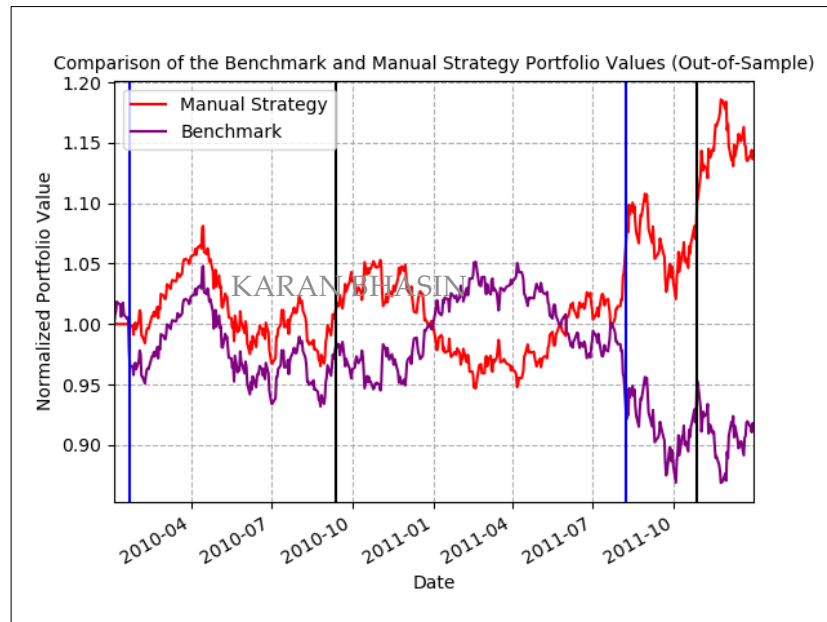


Figure 2— Comparison of benchmark and Manual Strategy portfolio values (out-of-sample)

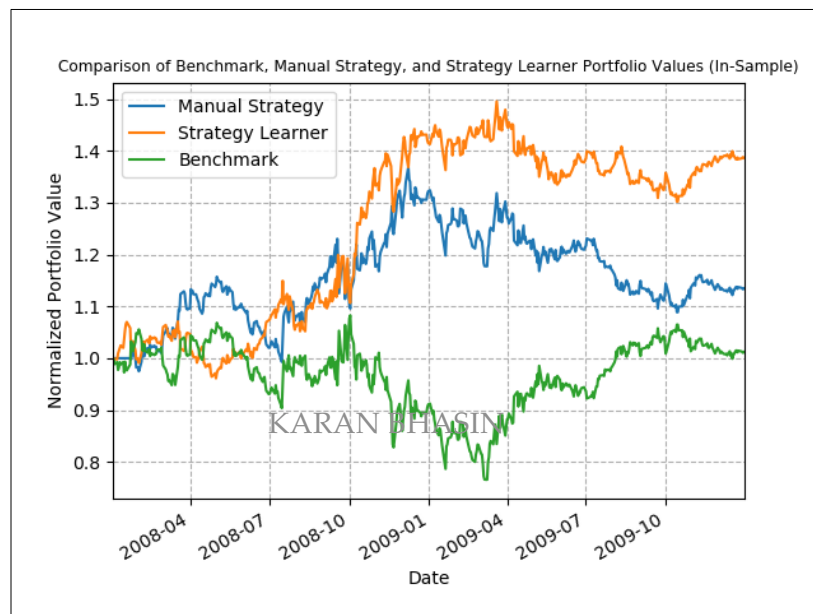


Figure 3— Comparison of benchmark, Manual Strategy, Strategy Learner portfolio values during the in-sample period

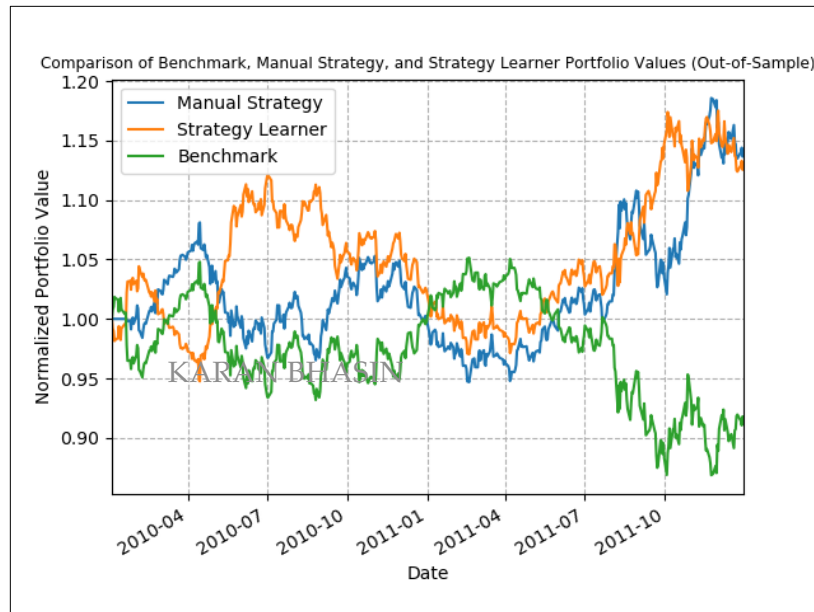


Figure 4— Comparison of benchmark, Manual Strategy, Strategy Learner portfolio values during the out-of-sample period

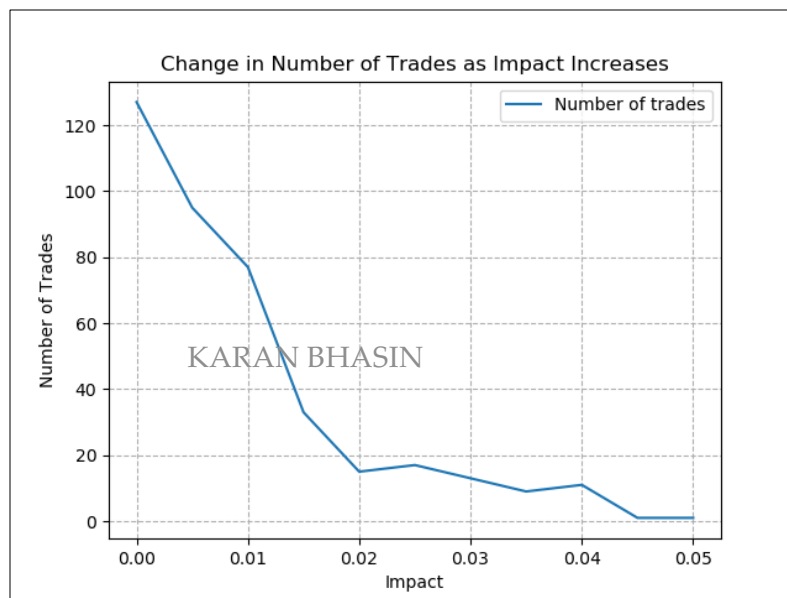


Figure 5— Change in number of trades as impact increases

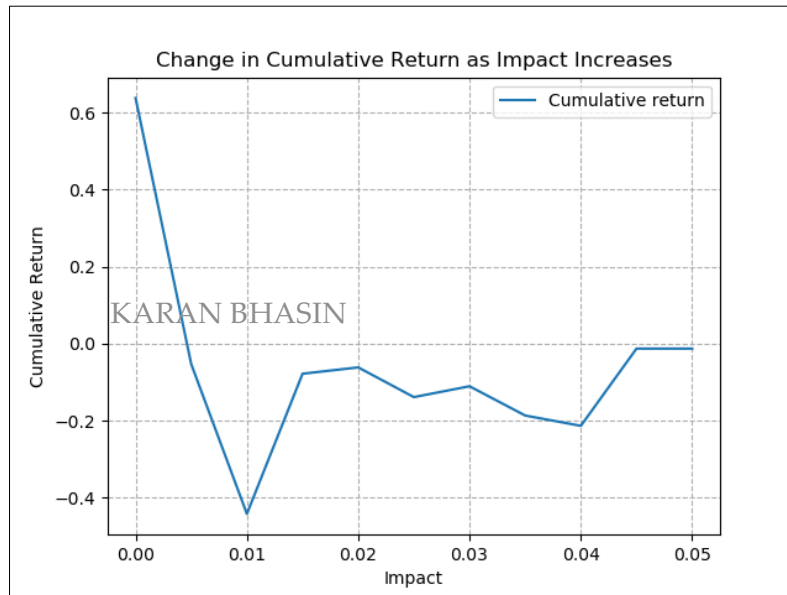


Figure 6— Change in cumulative return as impact increases

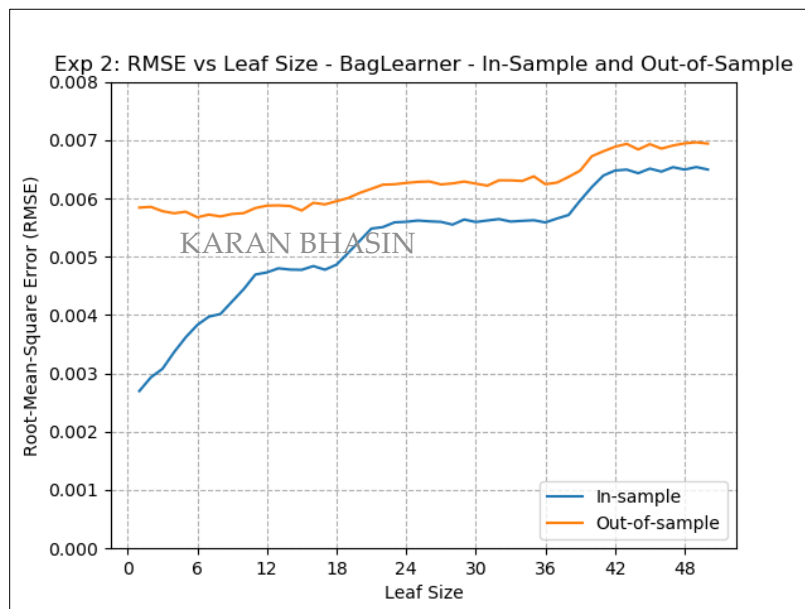


Figure 7— Root-mean-square error vs leaf size for in and out-of-sample testing for a bag learner