

MARKET NEUTRAL MOMENTUM STRATEGY	
Inter IIT TechCamp 2024	

OVERVIEW

<i>Project Name</i>	Market Neutral Momentum Trading Strategy for NIFTY 50 (2019-2023)
<i>Submitted by</i>	Abhishek Das -Team Zeta
<i>Project Objective</i>	Craft and execute a Market Neutral Momentum Trading strategy utilizing the esteemed companies of the NIFTY 50 index. The aim is to conjure a strategy and conduct back testing across diverse time frames, evaluating the allure of profitability and the shadows of risk entwined with long and short positions, all guided by the whispers of momentum signals.
<i>Code Link</i>	https://colab.research.google.com/drive/1HUGEHXBUUjdZVsPaXOIQbMHWqE-d0ruz#scrollTo=OKZKMoKBGITl

PROJECT SPECIFICS

<p><i>Project Scope</i></p>	<p>The project focuses on designing and implementing a Market Neutral Momentum Trading strategy using companies listed in the NIFTY 50 index. It involves creating a strategy and back testing it over various time periods. Specific objectives include profitability and risk assessments, momentum scoring using technical indicators, strategy development, visualization of key insights, and performance evaluation.</p> <ul style="list-style-type: none"> • Duration: Back test for 5 years (Jan 2019 - Dec 2023). • Resources: Yahoo Finance for data, Python, historical NIFTY 50 data.
<p><i>Project Constraints</i></p>	<p>Initial Capital: INR 10,00,000.</p> <p>Deadline: October 7th, 12:00 PM for submission, followed by presentations at 6:00 PM.</p> <p>Neutral Market Exposure: The strategy must maintain a balanced portfolio by taking both long and short positions to minimize market risk.</p> <p>Risk Management: Proper risk management measures and minimizing systemic risk are critical</p>
<p><i>Deliverables</i></p>	<ul style="list-style-type: none"> • Code File: Fully functioning trading strategy with all components implemented. • Strategy Presentation: A file outlining the strategy, including momentum scoring, trading signals, portfolio PnL, and performance metrics. • Visualization: Comprehensive charts and graphs illustrating cumulative returns, risk-adjusted performance, and trade-level analysis.
<p><i>Research paper & References</i></p>	<ul style="list-style-type: none"> • “<i>PHYSICAL MOMENTUM IN THE INDIAN STOCK MARKET</i>”, by Tulasi Narendra Das Tripurana & Naresh Kumar Devulapally • “<i>The effectiveness of technical trading strategies: Evidence from Indian equity markets</i>” • in.tradingview.com

INTRODUCTION

This Market Neutral Momentum Trading strategy is designed to profit from the momentum of securities while maintaining a neutral exposure to the overall market. By **taking long positions in stocks with the highest momentum (expected outperformers) and short positions in stocks with the lowest momentum (expected underperformers)**, we aim to reduce systemic market risk while capturing momentum-based profits.

This report outlines the methodology, performance metrics, and visual analysis of the strategy applied to **companies listed in the NIFTY 50 index from January 2019 to December 2023**.

Momentum Scoring Criteria

In this strategy, we calculate momentum scores based on a combination of technical indicators that measure price movement, volatility, and market sentiment. The following formulas were used to compute the momentum scores:

- Log Returns:

$$\text{Log Return} = \ln \left(\frac{\text{Price}_t}{\text{Price}_{t-1}} \right)$$

Log returns are preferred as they are additive over time.

- Turnover Rate:

$$\text{Turnover Rate} = \frac{\text{Volume Traded}}{\text{Shares Outstanding}}$$

This measures how frequently the shares are traded over a period.

- Volatility:

$$\text{Volatility} = \text{Rolling Standard Deviation of Returns}$$

This captures the risk and fluctuations in stock returns.

- Momentum Types:

- Momentum $p1$: $\text{Momentum} = \sum (\text{Turnover Rate} \times \text{Log Returns})$
- Momentum $p2$: $\frac{\sum (\text{Turnover Rate} \times \text{Log Returns})}{\sum \text{Turnover Rate}}$
- Momentum $p3$: $\frac{\text{Average Returns}}{\text{Volatility}}$

Trading Strategy and Signal Generation Method

Long Positions: Top 10% of stocks with the highest momentum scores are placed in the long portfolio.

Short Positions: Bottom 10% of stocks with the lowest momentum scores are shorted.

Portfolios are constructed and held for 4 months with a 3-month lookback period to calculate the momentum.

Back testing Methodology:

- **Period:** January 2019 to December 2023.
- **Initial Capital:** ₹10,00,000.
- **Holding Period:** 4 months.
- **Lookback Period:** 3 months.

Look back period can vary from 1-12 months and holding can vary from 3-12 months, making it a medium horizon strategy

On the first valid trading day of a month we make a new portfolio based on momentum scores and then it's liquidated at the end of holding period.

Risk Management Measures

The strategy is designed to minimize exposure to broad market movements through:

- **Market Neutrality:** Equal allocation to long and short positions ensures that overall market movements do not drastically affect the portfolio.
- **Volatility-Based Momentum:** Stocks with high volatility are penalized in certain momentum types to avoid overly risky assets.

Drawdown Monitoring: Maximum drawdown is actively tracked to measure the strategy's worst performance during the backtesting period.

Capital Allocation under Market Neutral Strategy

1. Initial Capital:

We start with an **initial capital of ₹10,00,000.**

2. Equal Split Between Long and Short Positions:

- Each month, we construct portfolios by ranking stocks based on momentum scores.
- **50%** of the capital is allocated to the long portfolio, which contains the stocks with the highest momentum (top-performing).
- **50%** of the capital is allocated to the short portfolio, which contains the stocks with the lowest momentum (underperformers).

3. Equal Weighting within Portfolios:

Within both the long and short portfolios, the **capital is equally distributed among the selected stocks**. For example, if there are 5 stocks in the long portfolio and 5 in the short portfolio:

Long Allocation: ₹5,00,000 is equally distributed among the top 5 stocks, so each stock receives ₹1,00,000.

Short Allocation: Similarly, ₹5,00,000 is equally distributed among the bottom 5 stocks for short positions, with each stock receiving ₹1,00,000 in short exposure.

4. Overlapping Portfolios:

Since portfolios are held for 4 months and new portfolios are constructed every month, capital is **allocated across multiple overlapping portfolios**. Each month, part of the capital is **reallocated** to the newly constructed portfolio while **maintaining the positions** of previous portfolios that are **still within their holding period**.

5. Balancing Market Exposure:

By allocating equal amounts to both long and short positions, the **portfolio aims to be neutral to market-wide movements**. If the market rises or falls, the long and short positions will offset each other to a large extent, reducing the overall market risk.

6. Rebalancing:

The portfolio is **rebalanced monthly to ensure the equal split between long and short** positions, and to adjust for any changes in stock rankings based on momentum.

Trading Signals Generated and Position Sizing

- **Signal Generation:**
 - Long signals are generated for stocks in the **highest-ranked portfolio**.
 - Short signals are generated for stocks in the **lowest-ranked portfolio**.

- **Position Sizing: Equal weight allocation** is given to each stock in both the long and short portfolios, ensuring market neutrality.

Sample Trade:

On **March 1, 2020**, the following positions were opened based on momentum scores:

- **Long Portfolio:** Stocks with the highest momentum, e.g., HDFCBANK, RELIANCE.
- **Short Portfolio:** Stocks with the lowest momentum, e.g., COALINDIA, NTPC.

Performance Metrics

The following metrics were calculated using the `calculate_performance_metrics()` function:

1. Total Return (TR)

The total return measures the overall return of the portfolio over the entire trading period. It is given by:

$$\text{Total Return} = \frac{\text{Final Portfolio Value} - \text{Initial Capital}}{\text{Initial Capital}}$$

Where:

- Final Portfolio Value is the value of the portfolio at the end of the trading period.
- Initial Capital is the initial investment.

2. Annualized Return (AR)

Annualized return measures the compounded return per year over the entire trading period:

$$\text{Annualized Return} = (1 + \text{Total Return})^{\frac{1}{T}} - 1$$

Where:

- T is the number of years in the trading period.

3. Sharpe Ratio (SR)

The Sharpe Ratio is a risk-adjusted return metric. It measures the excess return per unit of risk (standard deviation of returns). The formula is:

$$\text{Sharpe Ratio} = \frac{\bar{R} - R_f}{\sigma_R} \times \sqrt{252}$$

Where:

- \bar{R} is the average return of the strategy (mean of the strategy returns).
- R_f is the risk-free rate (if not provided, it is assumed to be 0).
- σ_R is the standard deviation of returns (the risk of the strategy).
- 252 is the number of trading days in a year.

4. Sortino Ratio (SoR)

The Sortino Ratio is a variation of the Sharpe Ratio, but instead of using standard deviation as the risk measure, it uses downside deviation, which only accounts for negative returns:

$$\text{Sortino Ratio} = \frac{\bar{R} - R_f}{\sigma_D} \times \sqrt{252}$$

Where:

- σ_D is the downside deviation, calculated only from the negative returns (downside risk).

The downside deviation σ_D is calculated as:

$$\sigma_D = \sqrt{\frac{1}{n} \sum_{i=1}^n \min(R_i - R_f, 0)^2}$$

Where:

- R_i are the individual returns of the strategy.
- R_f is the risk-free rate.
- The term $\min(R_i - R_f, 0)$ ensures only negative returns are considered.

5. Maximum Drawdown (MDD)

The maximum drawdown measures the maximum observed loss from a portfolio's peak to its trough over the trading period:

$$\text{Max Drawdown} = \min \left(\frac{\text{Portfolio Value}_t}{\max(\text{Portfolio Value}_{0 \rightarrow t})} - 1 \right)$$

Where:

- Portfolio Value_t is the value of the portfolio at time t .
- $\max(\text{Portfolio Value}_{0 \rightarrow t})$ is the maximum portfolio value observed up to time t .

6. Trade Frequency (TF)

Trade frequency estimates how often trades occur per year. Assuming 21 trading days per month:

$$\text{Trade Frequency} = \frac{252}{\text{Holding Months} \times 21}$$

Where:

- Holding Months refers to the average holding period of trades in months.

Results

Here we compare the results of back testing of our strategy, based on the following settings -

- start_date = '2019-01-01'
- end_date = '2023-12-31'
- lookback_months = 3
- holding_months = 4
- initial_capital = 1000000

Using momentum “p1” -

<i>Total Returns in the backtesting period</i>	410.41%
<i>Annualized Returns</i>	25.24%
<i>Sharpe Ratio</i>	7.80
<i>Sortino Ratio</i>	1.42
<i>Max Drawdown</i>	-9.60%

Using momentum “p2” -

<i>Total Returns in the backtesting period</i>	678.55%
<i>Annualized Returns</i>	32.77%
<i>Sharpe Ratio</i>	11.15
<i>Sortino Ratio</i>	1.25
<i>Max Drawdown</i>	-10.93%

Using momentum “p3” -

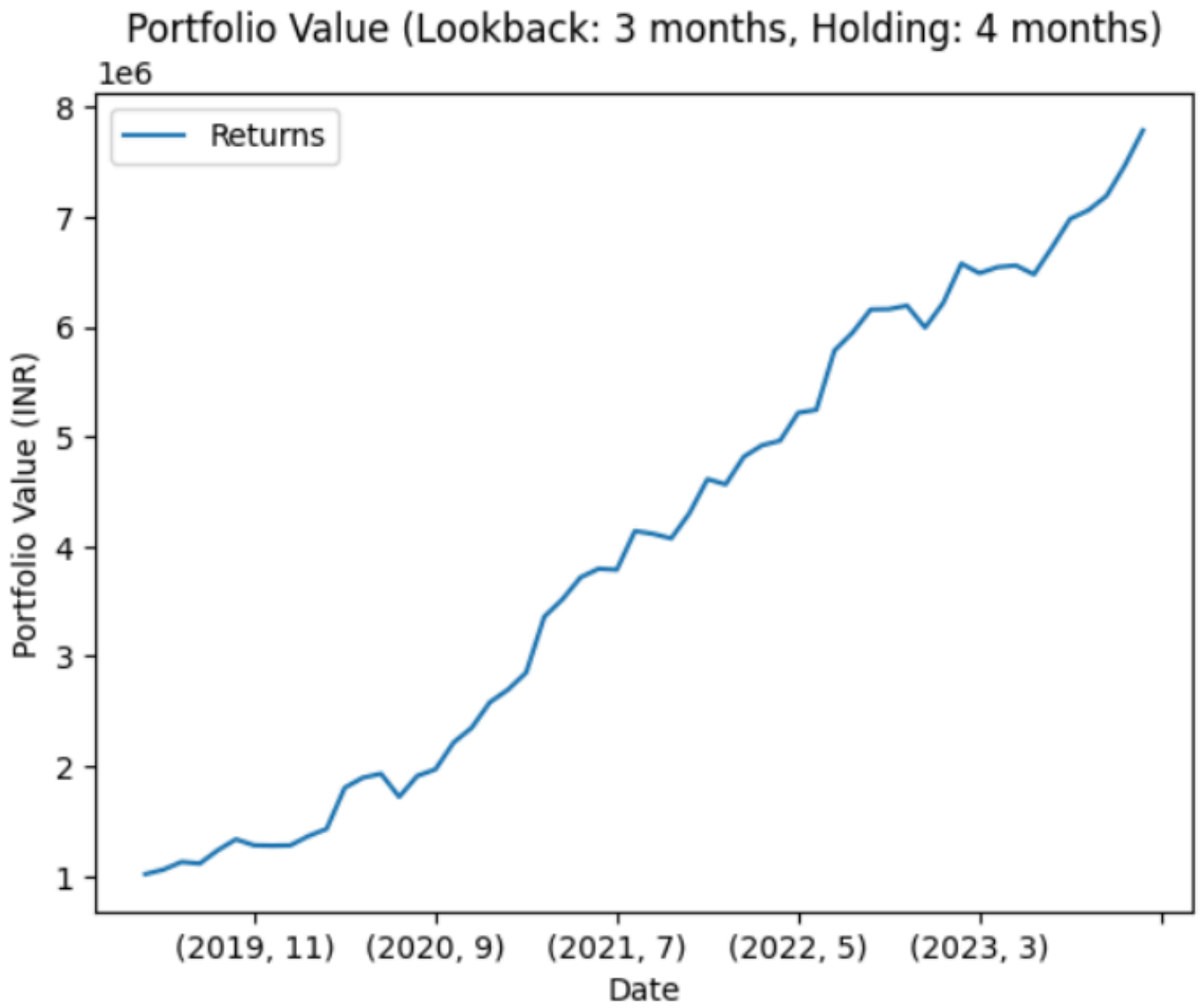
<i>Total Returns in the backtesting period</i>	218.75%
<i>Annualized Returns</i>	17.36%
<i>Sharpe Ratio</i>	12.23
<i>Sortino Ratio</i>	1.44
<i>Max Drawdown</i>	-3.73%

NIFTY 50 Metrics

<i>Total Returns in the backtesting period</i>	101.36%
<i>Annualized Returns</i>	15.04%
<i>Sharpe Ratio</i>	0.79

Visualizations for “p2” Momentum

- *Portfolio Value over the entire backtesting period*



- *Portfolio Values*

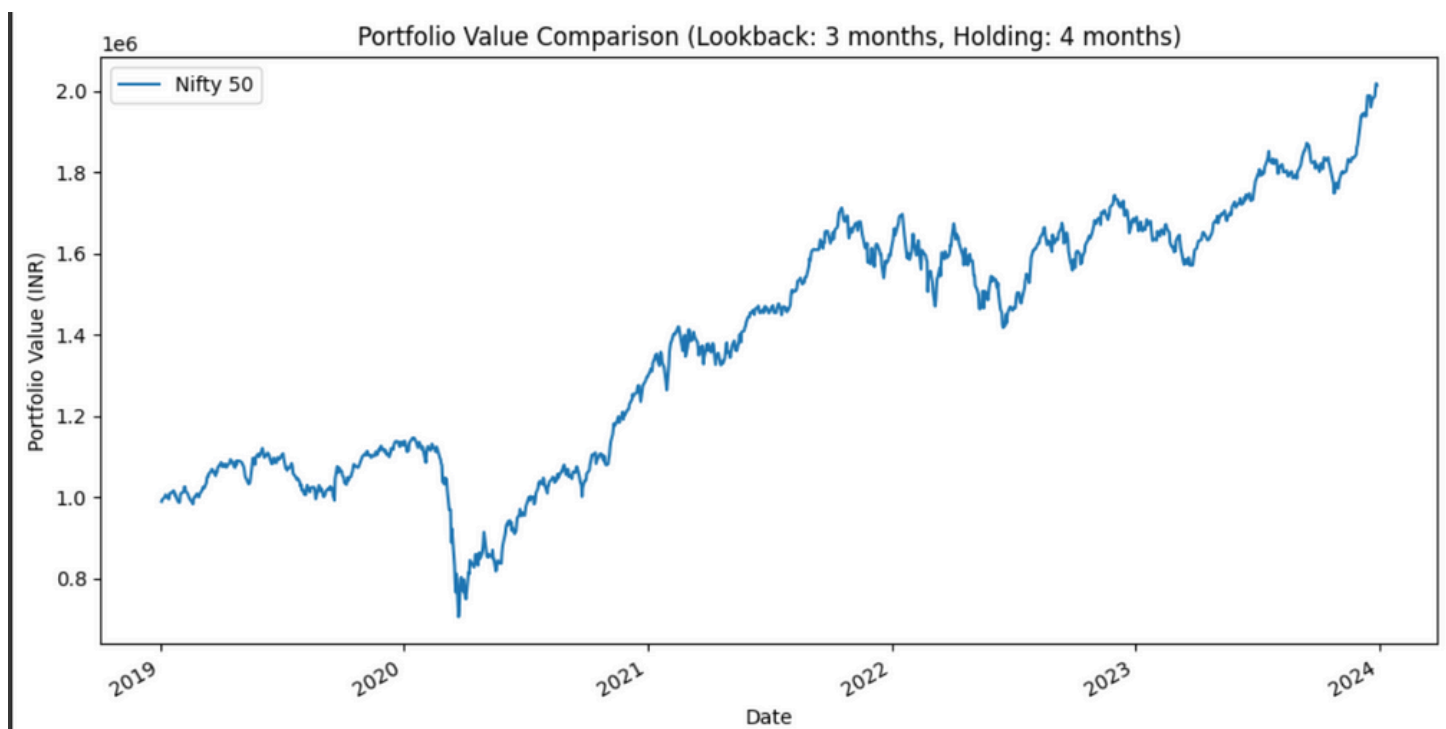
portfolio_value		
Date		Returns
2019	1	NaN
	2	NaN
	3	NaN
	4	NaN
	5	1014701.920092
	6	1055612.742736
	7	1125655.161445
	8	1110892.207316
	9	1232291.742808
	10	1331923.886839
	11	1277234.988545
	12	1273731.19066
2020	1	1276452.621813
	2	1361597.47046
	3	1427098.473164
	4	1801590.917099
	5	1893166.751733
	6	1928858.565095

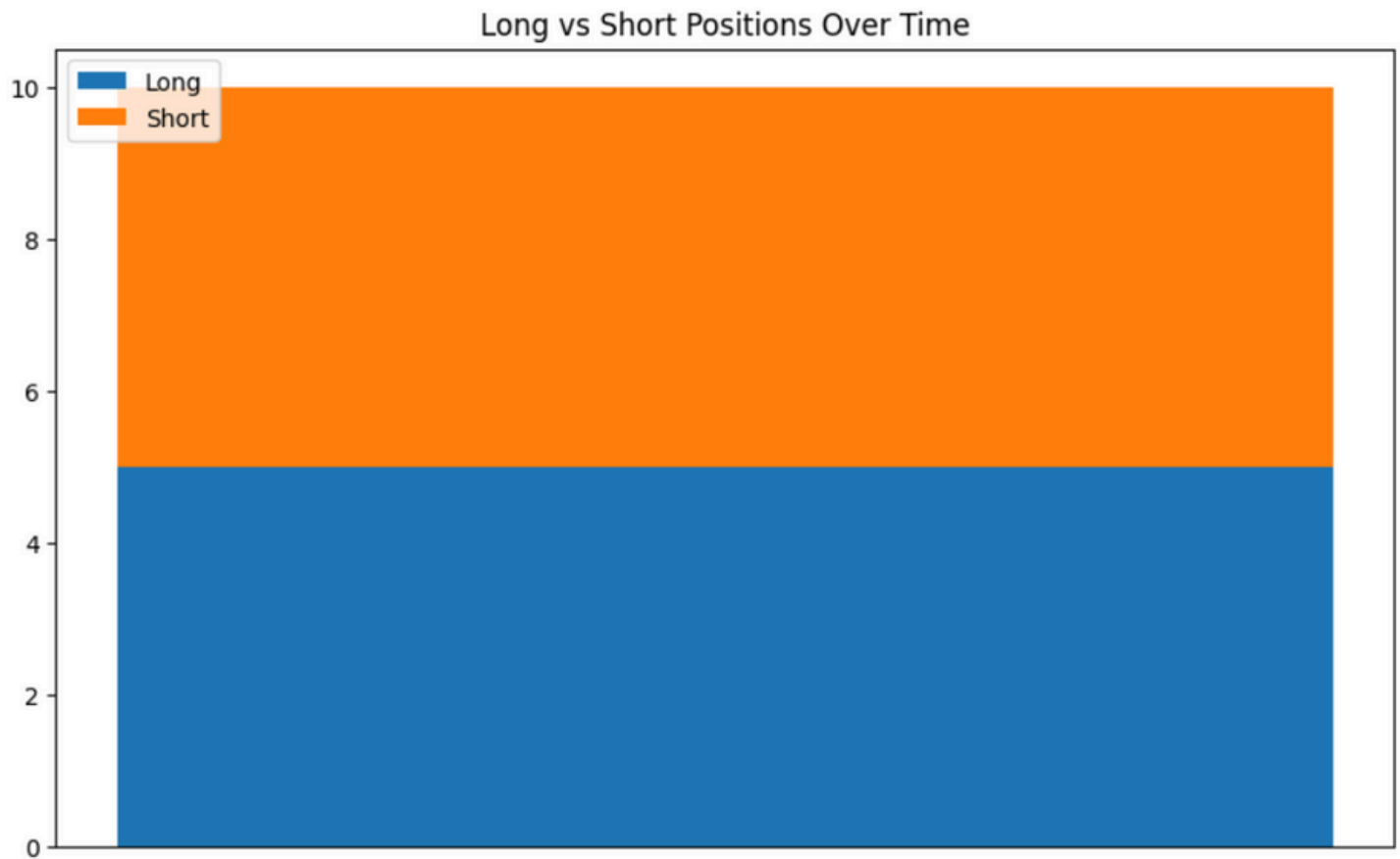
- *Momentum Scores of some stocks*

✓ [20] top_bottom_stocks.tail(20)

	Date	Position	Symbol	Momentum Score
580	(2023, 11)	Long	COALINDIA.NS	0.072990
581	(2023, 11)	Long	HCLTECH.NS	0.037524
582	(2023, 11)	Long	BAJAJ-AUTO.NS	0.031381
583	(2023, 11)	Long	MARUTI.NS	0.030688
584	(2023, 11)	Long	NTPC.NS	0.030326
585	(2023, 11)	Short	ITC.NS	-0.031087
586	(2023, 11)	Short	JSWSTEEL.NS	-0.035018
587	(2023, 11)	Short	HDFCBANK.NS	-0.041236
588	(2023, 11)	Short	ASIANPAINT.NS	-0.044862
589	(2023, 11)	Short	UPL.NS	-0.061515
590	(2023, 12)	Long	COALINDIA.NS	0.145505
591	(2023, 12)	Long	HEROMOTOCO.NS	0.120050
592	(2023, 12)	Long	BPCL.NS	0.102479
593	(2023, 12)	Long	NTPC.NS	0.097133
594	(2023, 12)	Long	BAJAJ-AUTO.NS	0.083239

- *Returns of NIFTY 50*





Conclusion

After evaluating the three momentum strategies ("p1," "p2," and "p3"), **momentum strategy "p2"** emerged as the most effective option:

- **Total Returns:** "p2" achieved **679.06%**, outperforming "p1" (410.41%) and "p3" (218.75%).
- **Annualized Returns:** "p2" delivered **32.77%**, exceeding both "p1" (25.24%) and "p3" (17.36%).
- **Sharpe Ratio:** At **11.15**, "p2" offered the best risk-adjusted returns, despite "p3" (12.23) having a slightly higher Sharpe Ratio.
- **Sortino Ratio:** "p2" maintained competitive performance with **1.25**, close to "p1" (1.42) and "p3" (1.44).
- **Max Drawdown:** "p2" had a Max Drawdown of **-10.93%**, acceptable given its superior returns.

Additionally, NIFTY index metrics showed:

- **Initial Portfolio Value:** ₹1,000,000.00

- **Final Portfolio Value: ₹2,013,565.01**
- **Total Return: 101.36%**
- **Annualized Return: 15.04%**
- **Annualized Volatility: 19.11%**
- **Sharpe Ratio: 0.79**

Given its exceptional performance metrics, **momentum strategy "p2"** is the optimal choice, demonstrating that momentum trading can significantly enhance portfolio outcomes compared to passive strategies.