EFFICACY OF PRICE ACTION TRADING STRATEGIES IN THE CONTEXT OF THE INDIAN EQUITIES MARKET

Final Report

Team 53

Inter IIT Tech Meet 11.0

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Introduction

The elusive and unpredictable nature of financial markets has long been a source of intrigue and fascination for academic researchers and professional investors. With the high stakes for successful predictions, predictive analysis has emerged as a critical player in the decision-making processes of the finance industry. In this report, we examine the effectiveness of candlestick patterns and price action trading strategies in the context of the Indian equities market. Through developing and testing three distinct hypotheses, we aim to provide a nuanced and insightful examination of these techniques and contribute to the ongoing discourse on financial predictions.

We suggest the following three hypotheses based on candlestick patterns and price action.
In Hypothesis 1, we use the doji candlestick and some quantitative methods to predict trends in the market.
In the 2nd hypothesis, we use the mean reversion technique augmented by Engulfing and Harami candles to forecast price movement.
The 3rd hypothesis utilises a breakout strategy based on identifying uptrends using higher highs and higher lows.

The following are some keywords used in this report;
Liquid stocks - A liquid stock is a stock that can be easily bought or sold in the market without affecting its price significantly. This is because many shares are available, and there is a high demand for the stock.
High Momentum stocks - On the other hand, They have experienced a significant price increase over a short period and are expected to continue their upward trend. These stocks are often favoured by traders who are

looking for quick profits. However, momentum stocks can also be volatile, and their prices can drop quickly if market sentiment changes or there is a negative news development.

Market Sentiments - Market sentiment refers to the overall attitude of investors toward a particular security or financial market. It is the feeling or tone of a market, or its crowd psychology, as revealed through the activity and price movement of the securities traded in that market. In broad terms, rising prices indicate bullish market sentiment, while falling prices indicate bearish market sentiment.

Price Action Strategy - In simple terms, price action is a trading technique that allows a trader to read the market and make subjective trading decisions based on the recent and actual price movements, rather than relying solely on technical indicators.

Candlestick Patterns - Candlestick charts are a technical tool that packs data for multiple time frames into single price bars. This makes them more useful than traditional open, high, low, close (OHLC) bars or simple lines that connect the dots of closing prices. Candlesticks build patterns that may predict price direction once completed.

Universe Selection - Banking sector, Metal sector, IT sector, Auto sector. All of these include combination of seven to eight large cap stocks from the sector.

Hypothesis 1

Combination of Mean Reversion & Engulfing or Harami Candlestick Patterns is highly effective for Large Cap and Liquid Indian Equities.

Mean Reversion Technique - Mean reversion trading in equities tries to capitalise on extreme changes in the pricing of a particular security, assuming it will revert to its previous state.

Engulfing Candlestick patterns - An Engulfing candlestick pattern is a two-candle reversal pattern in technical analysis of financial markets. This happens when a small candle is followed by a large candle that completely engulfs the previous candle. If the second candle is bullish (i.e., the close is higher than the open), the Engulfing pattern is considered a potential bullish reversal pattern. If the second candle is bearish (i.e., the close is lower than the open), the Engulfing pattern is regarded as a potential bearish reversal pattern. The Engulfing pattern indicates a potential change in market sentiment and suggests that the previous trend may no longer be in effect.

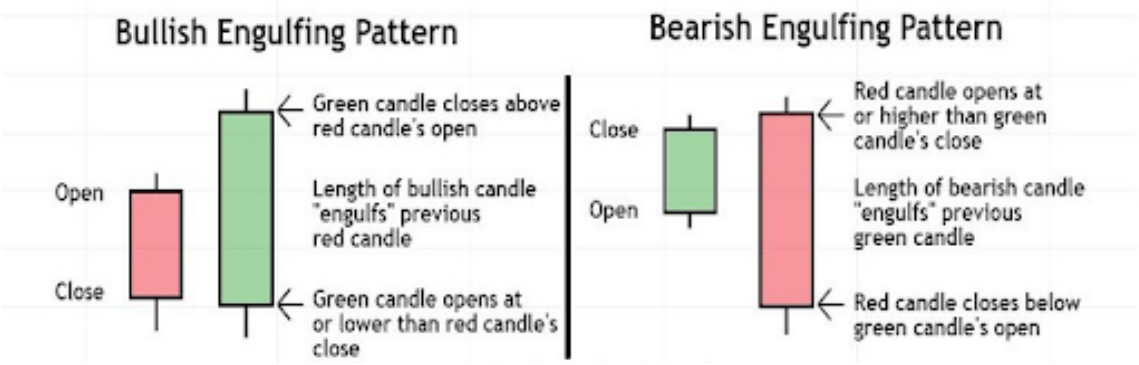


Figure 1: Engulfing Candlestick Pattern

Harami Candlestick patterns: A Harami candlestick pattern is a two-candle reversal pattern in technical analysis of financial markets. It occurs when a small candlestick is contained within the range of a larger candle of the opposite colour. The pattern is considered a potential bullish reversal if the second candle is bullish (i.e., the close is higher than the open). The first candle is bearish (i.e., the close is lower than the open), and a potential bearish reversal pattern if the second candle is bearish and the first candle is bullish. The Harami pattern is usually a sign of indecision in the market and suggests that the current trend may be losing momentum.

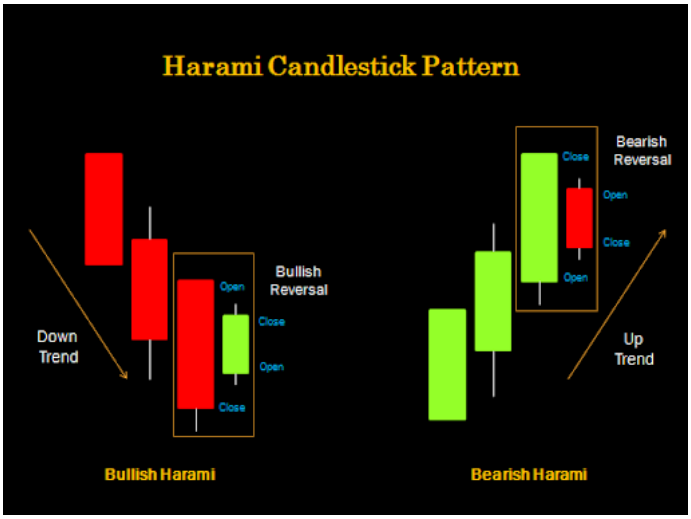


Figure 2: Harami Candlestick Pattern

Thought Process

A strategic amalgamation using engulfing and harami candlestick patterns has been incorporated to bolster the implementation of the mean reversion technique. The mean reversion strategy dictates that when the market deviates from its mean, for example when the current candle's price falls below the 200-day moving average, then the stock can be purchased. However, as an added assurance, before executing the purchase, confirmation of either a bullish harami or a bullish engulfing candlestick pattern is sought. On the contrary, for prices that surpass the SMA, an observa-

tion of bearish harami and bearish engulfing candlesticks is made before making a trade, thereby increasing the precision of the investment. Since candlestick patterns offer a more accurate representation of the market sentiment. Therefore, integrating these two techniques enhances the reliability of the long and short calls.

Strategy details

We continually monitor the 200-day moving average. If the current price dips below this benchmark, we scout for bullish harami and bullish engulfing patterns. Upon spotting either of these, we initiate a buy signal as soon as the next candle breaks the previous candle's high.

(a) Harami Candle (b) Engulfing Candle

Figure 3: Formation of Candlestick Patterns

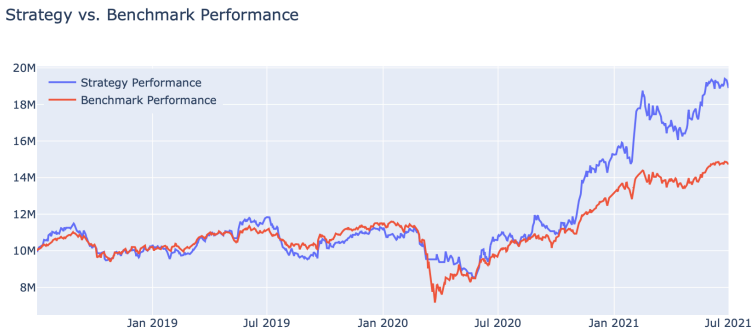
Our stop loss is set at the minimum of the two preceding candles, while our target is set as the previous candle high plus 3 times the difference between the previous candle high and low, keeping a risk reward ratio of 1:3. For prices that exceed the 200-day moving average, the converse of the above method is employed, providing a consistent approach to achieve our investment objectives.

Backtesting Result

We have backtested this strategy regressively on the various equity universes, some of which are shown below -

- Large Cap Banking sector

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	10,000,000	18,895,826



Performance Metrics

Annual Returns	24.25 %
Cumulative Returns	89.04 %
Annual Volatility	23.41 %
Sharpe Ratio	1.04
Maximum Drawdown	-27.91 %
Omega Ratio	1.2
Sortino Ratio	1.54
Skew	-0.1
Kurtosis	4.3
Stability of Timeseries	49.22 %

Figure 4

- Large Cap Auto sector

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	10,000,000	21,637,280

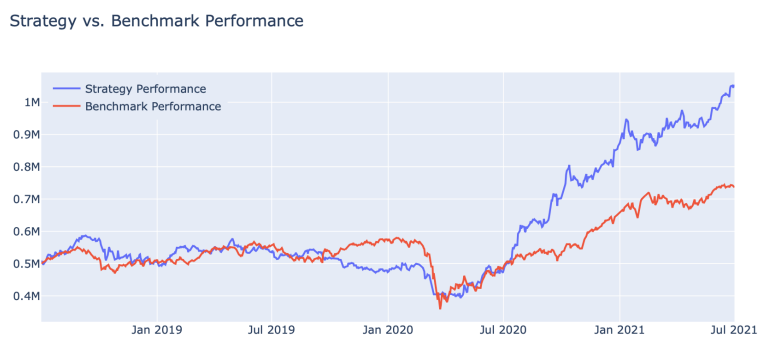
Performance Metrics

Annual Returns	30.08 %
Cumulative Returns	116.21 %
Annual Volatility	26.51 %
Sharpe Ratio	1.12
Maximum Drawdown	-26.34 %
Omega Ratio	1.25
Sortino Ratio	1.81
Skew	1.19
Kurtosis	11.21
Stability of Timeseries	65.27 %

Figure 5

- Large Cap IT sector

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	500,000	1,048,762



Performance Metrics

Annual Returns	28.74 %
Cumulative Returns	109.76 %
Annual Volatility	21.59 %
Sharpe Ratio	1.27
Maximum Drawdown	-33.1 %
Omega Ratio	1.25
Sortino Ratio	1.94
Skew	0.14
Kurtosis	3.22
Stability of Timeseries	45.17 %

Figure 6

- Large Cap Metal sector

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	1,000,000	2,972,259

Performance Metrics

Annual Returns	45.06 %
Cumulative Returns	197.69 %
Annual Volatility	26.4 %
Sharpe Ratio	1.54
Maximum Drawdown	-34.64 %
Omega Ratio	1.31
Sortino Ratio	2.37
Skew	0.01
Kurtosis	2
Stability of Timeseries	50.6 %

Figure 7

Outcome

The above backtests confirms that there is a potential change in market sentiment, which suggests that the previous trend may no longer be in effect. By combining these two candlestick patterns, we take advantage of both market volatility and changes in market sentiment to make informed trading decisions and maximize returns.

Hypothesis 2

Doji candlestick formations within the Indian financial market, particularly in sectors that are susceptible to interest rate fluctuations, is indicative of a robust positive correlation with the accuracy of breakout predictions.

Doji Candlestick Patterns - The Doji Candlestick pattern is formed when the opening and closing prices are nearly equal. This pattern reflects a state of indecision between buyers and sellers, hinting at the possibility of a trend reversal. There are four main types of doji formations.

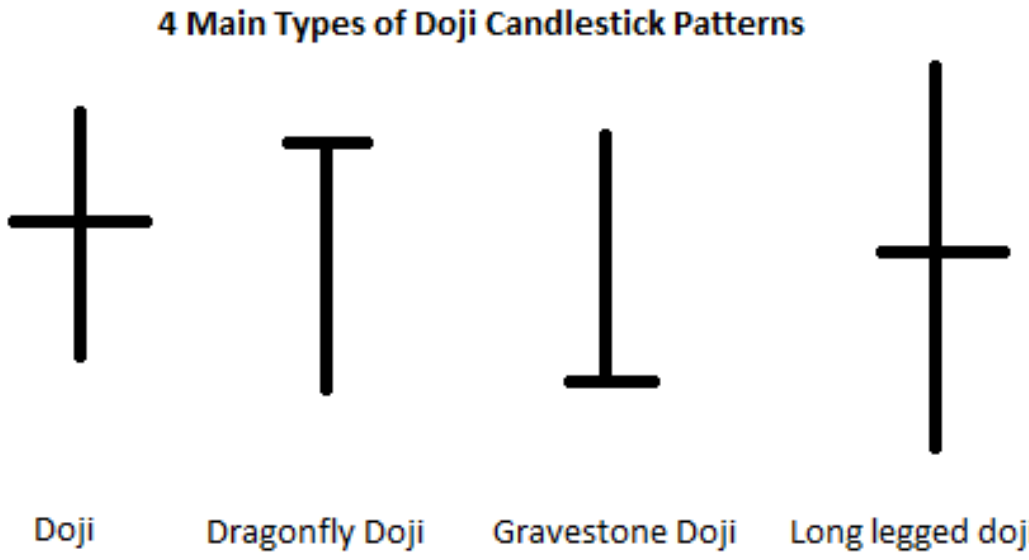


Figure 8: Doji candlestick

Thought Process

People use doji candlestick pattern to identify trend reversals however, we are using it for trend following. Our strategy has integrated the use of the

doji candle due to its indecision-predicting capability. However, it is imperative to note that, like any other candlestick pattern, reliance solely upon the doji pattern would be imprudent. To enhance its efficacy, we have employed the utilisation of standard deviation to augment the doji pattern. Stocks moving towards a particular price from average can show us the strength of buyers or sellers. Thus, it increases the chances of breakouts or breakdowns and prolonged price movement, and the standard deviation makes it easier to spot such occurrences.

Strategy details

When the stock price is within 30% of the calculated resistance level (Assumption), which is determined as 1.5 times the standard deviation from the average stock price, we observe a doji pattern at that level. The doji pattern indicates a lack of direction in the market and indecision among traders. To capitalize on this opportunity, we wait for confirmation of the trend by observing if the stock price crosses the high of the doji the following day, as depicted in Figure 9(a). If the high of the doji is crossed, we initiate a long position, with the stop loss placed at the low of the doji to minimize potential losses. The target profit is determined by adding three times the range (difference between the high and low) of the doji to the high of the doji.

When the stock price is below 70% of the calculated support level (Assumption), which is determined as 1.5 times the standard deviation from the average stock price, we observe a doji pattern at that level. The doji pattern indicates a lack of direction in the market and indecision among traders. To capitalize on this opportunity, we wait for confirmation of the trend by observing if the stock price crosses the low of the doji the following day, as depicted in Figure 9(b). If the low of the doji is crossed, we initiate a short position, with the stop loss placed at the high of the doji to minimize

(a) (b)

Figure 9: Long trade and Short trade

potential losses. The target profit is determined by subtracting three times the range (difference between the high and low) of the doji to the low of the doji.

Backtesting Result

We have backtested this strategy regressively on the various equity universes, some of which are shown below -

- Large Cap Banking sector

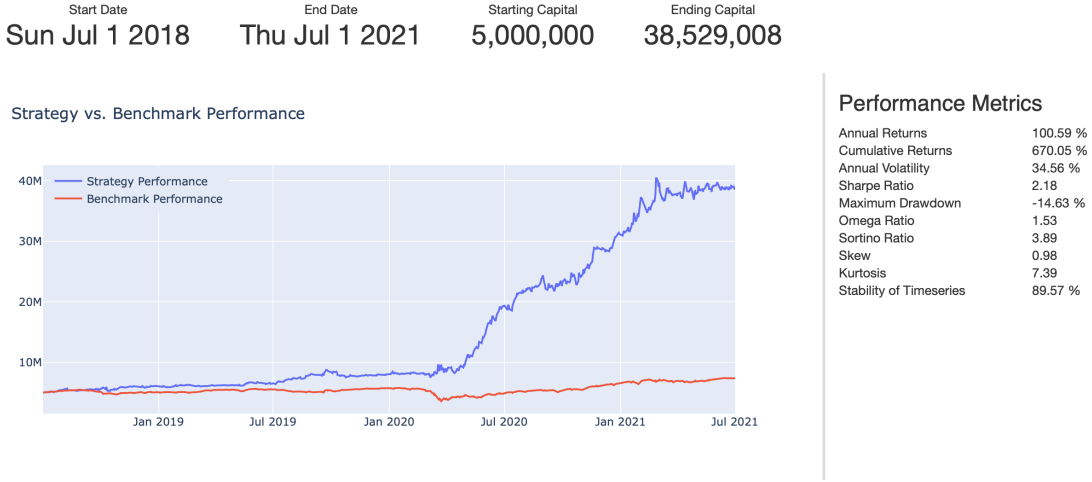
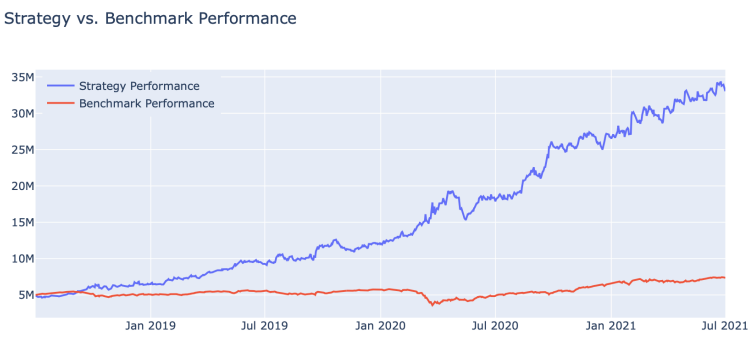


Figure 10

- **Large Cap Auto sector**

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	5,000,000	33,028,508



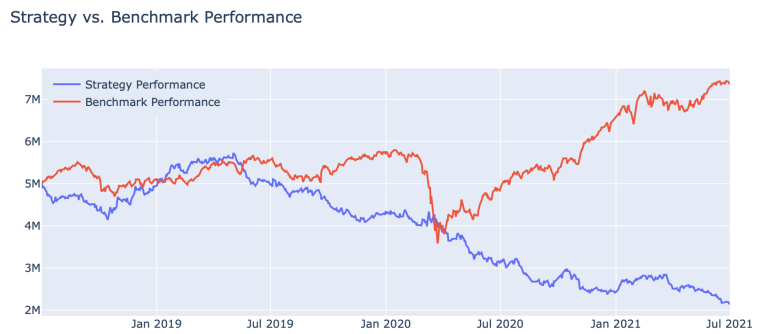
Performance Metrics

Annual Returns	90.38 %
Cumulative Returns	560.65 %
Annual Volatility	31.48 %
Sharpe Ratio	2.2
Maximum Drawdown	-20.83 %
Omega Ratio	1.49
Sortino Ratio	3.84
Skew	0.83
Kurtosis	5.63
Stability of Timeseries	99.06 %

Figure 11

- **Large Cap IT sector**

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	5,000,000	2,172,496



Performance Metrics

Annual Returns	-24.73 %
Cumulative Returns	-56.54 %
Annual Volatility	21.93 %
Sharpe Ratio	-1.18
Maximum Drawdown	-62.32 %
Omega Ratio	0.81
Sortino Ratio	-1.63
Skew	0.37
Kurtosis	3.43
Stability of Timeseries	81.8 %

Figure 12

- Large Cap Metal sector

Figure 13

Outcome

The doji candlestick pattern has been shown to positively correlate with the accuracy of breakout predictions for sectors that are connected to interest rate fluctuations in the Indian market. The banking and automotive industries are the most vulnerable to changes in the repo rate. This suggests that traders and investors can use doji patterns as a valuable tool in their market analysis and decision-making process, especially when considering investments in sectors that are sensitive to changes in interest rates.

Hypothesis 3

A resistance breakout buying strategy, characterized by the acquisition of securities subsequent to the breach of resistance levels in highly liquid and high-momentum Indian Equities, holds the potential to generate substantial returns.

Dow Theory suggests that the markets are made up of three distinct, self-repeating phases. These are called the Accumulation phase, the Markup phase, and the Distribution phase. The Accumulation phase usually occurs right after a steep sell-off in the market. The steep sell-off in the markets would have frustrated many market participants, losing hope of any price uptrend. The stock prices would have plummeted to rock bottom valuations, but the buyers would still be hesitant to buy, fearing another sell-off. Hence the stock price languishes at low levels. This is when the 'Smart Money' enters the market. Stock market averages must confirm each other. This means that the signals that occur on one index must match or correspond with the signals on the other.

Thought Process

By adhering to the principles of Dow Theory, we can efficiently track market trends and capitalise on them by going long when a peak is breached, and the trend is substantiated. Higher highs and higher lows identify an UpTrend. A Trend is a direction in which the prices are moving based on where they have been in the past. Trends consist of peaks and troughs. The direction of those peaks and troughs make up the market's trend. Whether those peaks and troughs are moving up, down, or sideways indicates the

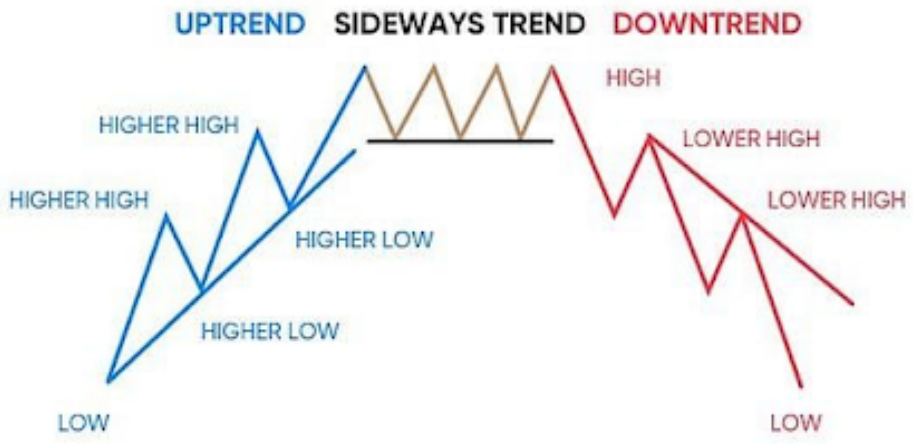


Figure 14

direction of the movement. We follow the trend till a previous swing high is broken, then the uptrend is confirmed, and we go long. All technical chart patterns like a double bottom, flag and pole, head and shoulder and range breakouts are covered in this since the higher high and higher low is the first thing that gets printed on the chart.

Strategy details

Strategy Details The strategy is pretty simple. We identify a trend whenever a higher high and higher low is made by confirming if the previous swing high is broken and the market closes above the previous swing high. We go long when the previous swing high is broken, and the market is above the 40-day simple moving average, confirming a medium-term uptrend. The stop loss is set to the previous swing low, with initially no target selected. We just trail the stop loss to swing low every time, thus capturing the maximum trend possible.

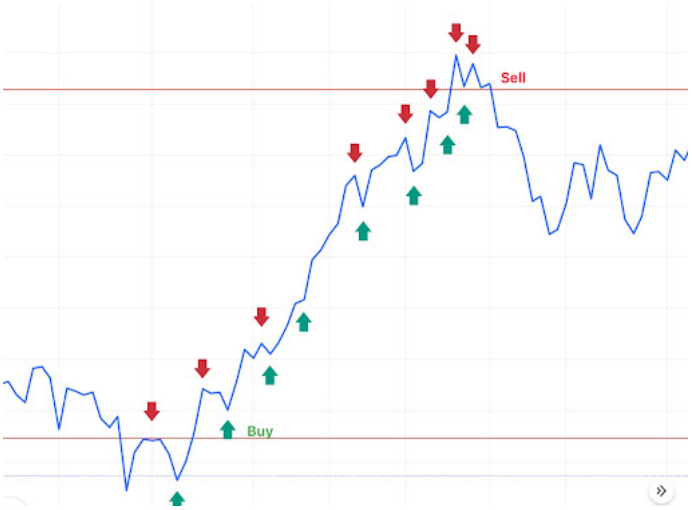


Figure 15: Long trade

Backtesting Result

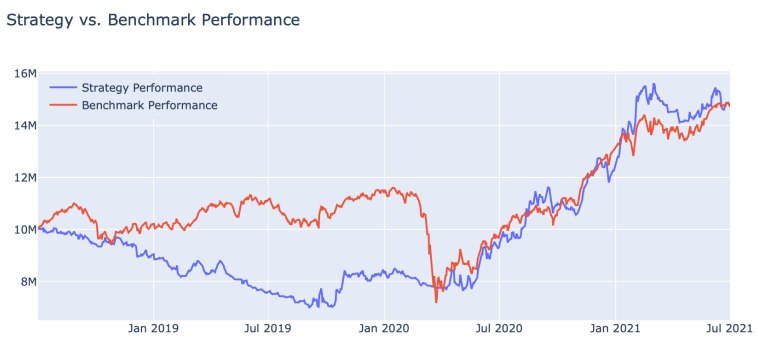
We have backtested this strategy regressively on the various equity universes, some of which are shown below -

- Large Cap Banking sector

Figure 16

- **Large Cap Auto sector**

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	10,000,000	14,831,077



Performance Metrics

Annual Returns	14.37 %
Cumulative Returns	48.27 %
Annual Volatility	20.19 %
Sharpe Ratio	0.76
Maximum Drawdown	-30.68 %
Omega Ratio	1.16
Sortino Ratio	1.16
Skew	0.33
Kurtosis	7.81
Stability of Timeseries	43.25 %

Figure 17

- **Large Cap IT sector**

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	10,000,000	20,326,882

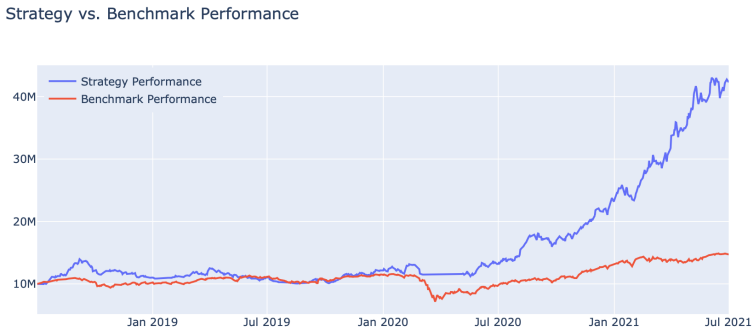
Performance Metrics

Annual Returns	27.36 %
Cumulative Returns	103.24 %
Annual Volatility	15.62 %
Sharpe Ratio	1.62
Maximum Drawdown	-14.23 %
Omega Ratio	1.35
Sortino Ratio	2.67
Skew	0.73
Kurtosis	5.89
Stability of Timeseries	66.48 %

Figure 18

- Large Cap Metal sector

Start Date	End Date	Starting Capital	Ending Capital
Sun Jul 1 2018	Thu Jul 1 2021	10,000,000	42,304,571



Performance Metrics

Annual Returns	63.55 %
Cumulative Returns	323.19 %
Annual Volatility	25.03 %
Sharpe Ratio	2.09
Maximum Drawdown	-28.04 %
Omega Ratio	1.45
Sortino Ratio	3.36
Skew	0.18
Kurtosis	2
Stability of Timeseries	65.18 %

Figure 19

Outcome

The resistance breakout strategy is a widely used technical analysis technique in financial markets, based on the hypothesis that a price breakout above a level of resistance is a bullish signal that suggests the market is likely to continue to move higher. While this strategy has the potential to generate positive returns, it is crucial to approach it with caution and combine it with some other indicators to make informed decisions. In this case, the success of the code in the metal sector and banking stocks can be viewed as evidence of the efficacy of this approach in these particular industries. Furthermore, using a moving average to complement the local min/max prices as a signal generator further strengthens the robustness of this hypothesis.

Conclusion

The effectiveness of the hypotheses presented by us were proved by the rigorous backtesting results presented in this report.

Models	Sectors	Cumulative Returns(%)	Annual Returns(%)	Max Drawdown(%)	Sharpe Ratio
Hypothesis 1	Banks	89.04	24.25	-27.91	1.04
	Autos	116.21	30.08	-26.34	1.12
	Metals	197.69	45.06	-34.64	1.54
	IT	109.76	28.74	-33.1	1.27
Hypothesis 2	Banks	670.05	100.59	-14.63	2.18
	Autos	560.65	90.38	-20.83	2.2
	Metals	34.6	10.66	-25.92	0.48
	IT	-56.54	-24.73	-62.32	-1.16
Hypothesis 3	Banks	109.22	28.62	-14.58	1.3
	Autos	48.27	14.37	-30.68	0.76
	Metals	323.19	63.55	-28.04	2.09
	IT	103.24	27.36	-14.23	1.62

From the summary table presented above, we can conclude that -

- Mean Reversion and Candlestick Patterns can be useful technical analysis tools for trading large-cap and liquid Indian equities. The combination of Mean Reversion and Engulfing or Harami patterns may provide useful signals for entering and exiting trades.
- The 2nd Hypothesis works excellent for the sectors sensitive to the nation's interest rates. Doji patterns can be a valuable tool for traders in identifying potential market trends and making informed trade decisions, especially in banking and auto Indian stocks.
- Hypothesis 3 involves identifying key resistance levels and buying the security when it breaks through them. This can be a valuable tool for capturing the potential upside in security that shows strength.

Future Scope

The field of algo-trading is relatively new for retail investors in India; hence the future scope in it is enormous, and a lot can be done to improve the effectiveness and accuracy of the strategies formed. Some of them are-

- Integration of machine learning algorithms like LSTM, Regression, and Time-series enhances the algorithm's predictive capability.
- Parameter optimisation using ML for better-timed calls in the real market. Development of new algorithms by incorporating the general knowledge of the market using the programmable language.
- More and more combinations of candlestick patterns and indicators can be back-tested easily now and hence open the gates for the development of new amalgamations which can outperform the current market techniques.
- Incorporation of news and sentiment analysis, which can provide valuable information about market conditions and help traders make informed decisions, into algorithmic trading strategies to improve their responsiveness to real-time market events and conditions.
- With the ever-increasing infrastructural support for trading in India, High-Frequency Trading can provide faster and more efficient trading methods.

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Member contributions

AK: Conducted research and analysis on hypothesis one and three, and wrote a comprehensive report summarising the findings.

RAC: Focused on researching hypothesis one and provided technical support for debugging any issues encountered.

SOM: Focused on researching and implementing hypothesis two. Also contributed to manage the team

MIR: Contributed to the report writing process and assisted with coding the hypothesis to ensure its implementation was accurate and effective.

ANU: Was responsible for coding the hypothesis and conducting backtesting to evaluate its performance and potential for implementation in real-world scenarios.