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Are any of the "Harry Potter" indicators, better than Machine Learning algorithms for stock market analysis?

Dissertation

Sachin Sharma

January 12, 2023

1 Executive Summary

The stock market is a crucial element of a country's economy, as it represents the performance of publicly traded companies and serves as a barometer for the overall health of the business sector. In recent years, the stock market has garnered increasing attention from both individual and institutional investors, as well as from policymakers and academics. This is due in part to the significant impact that stock market movements can have on the economy and individual wealth.

It is generally difficult to accurately forecast the stock market, as it is influenced by a wide range of factors such as economic conditions, company performance, and global events. Many experts and analysts try to make predictions about the stock market, but there is no guarantee that their forecasts will be accurate. It is common for the stock market to exhibit significant fluctuations and movements that cannot be fully anticipated.

However, this does not mean that it is completely hopeless to try to forecast the stock market. While it is impossible to predict with complete accuracy, various tools and techniques can help you make informed decisions about your investments. For example, you can analyze financial statements, read market news and research reports, and use technical analysis to help you make informed decisions about your investments.

It is important to remember that investing in the stock market carries inherent risks, and it is important to approach it with caution and a long-term perspective. It is also a good idea to diversify your portfolio and to seek the advice of a financial professional before making any investment decisions.

As a result, the study of stock market behaviour and analysis has become an important area of research within finance and economics. Researchers have developed a wide range of approaches and techniques for analyzing stock market data, including fundamental analysis, technical analysis, and behavioural finance. These methods have been applied to a variety of research questions, including the predictability of stock returns, the determinants of stock price movements, and the impact of corporate governance on firm performance.

In this project, two methods are used to make future predictions. First is the use of technical indicators. Technical indicators are tools that analysts use to analyze financial markets and help make trading decisions. They are often used in conjunction with chart patterns and other forms of technical analysis to help traders identify trends, determine the strength of those trends, and make informed decisions about buying and selling securities.

Many different technical indicators can be used, each with its unique characteristics and applications. Some common technical indicators include Moving Averages, Bollinger bands, and the Relative Strength Index (RSI).

Moving averages are used to smooth out price data and help identify trends. Bollinger bands are used to measure the volatility of a security, while the relative strength index (RSI) is used to measure the strength of a trend.

The second approach is more probabilistic and is based on machine learning algorithms. We are going to use Logistic regression, Gaussian Naive Bayes, Support Vector Machine (SVM), Random Forest, and MLP Classifier approach to predict the market direction as (+1, -1). These five machine learning algorithms are commonly used in classification tasks and can potentially be used to predict the direction of the market (i.e., whether it will significantly go up or down) as (+1, -1).

This paper aims to contribute to the existing literature on stock market analysis by trying to find the statistical significance of commonly used market indicators to create a "super indicator" to predict stock movement. In the following sections, we will analyze the most commonly used technical indicators, compute the ideal mix of technical indicators, examine what machine learning algorithms are, and combine them with our market indicator combinations.

Notably, Technical indicators and Machine learning algorithms are only a tool, and it is crucial not

to depend completely on them, since they may provide misleading signals. They should be used in combination with other types of research, such as fundamental analysis and thorough market evaluation. This project is not meant to provide investment advice. It is not meant to substitute for expert financial counsel. Trading carries the risk for dependency. Consult your financial adviser prior to making any investing choices.

Contents

2 Introduction

It would be an understatement to claim that the year 2022 was very uncertain. Inflation in the United States peaked at over 9.1 percent in June and 11.1 percent in October of this year. This led to a crisis in the cost of living, as many families, even in some of the world's richest countries, were forced to choose between feeding and heating this winter. This year, the highly contagious Omicron strain of COVID-19 spread around the globe. The UK Health Security Agency has also recently identified two "cousins" of Omicron, as the virus continues to change. Russia's invasion of Ukraine on February 24 precipitated worldwide food and energy problems and displaced millions of people. Multiple temperature records have been broken throughout the world as a result of climate change. Everything from melting runways to devastating wildfires was caused by the record-breaking heat that year. The continent of Europe saw its driest summer in 500 years, with heat advisories issued for the majority of the continent. Due to the low water levels in the Yangtze river basin, hydroelectric plants in China were unable to produce electricity in the month of August, forcing many businesses to shut down. The floods in Pakistan from June to August killed 1,391 people and cost an estimated USD 30 billion in damage to houses, crops, and essential infrastructure. On November 15, 2022, more than 200 years later, the global population topped 8 billion. (world economic forums, 2023)

Despite all the negative news surrounding this year, the Dow Jones Industrial Average and the SP 500 are both optimistic for the time being. Strong corporate profitability and solid economic indicators, such as low unemployment and steady GDP growth, have propelled the market. Concerns about increasing interest rates and trade tensions have heightened market volatility, with some experts forecasting a possible fall in the near future. Considering this, sentiment is bearish, and many investors are pessimistic about the future performance of the market.

But why is the stock market so vital to the economy? The answer is:

- Capital allocation: The stock market enables investors to invest in companies they feel have a promising future. In turn, this supplies businesses with the money required to build and expand their operations.
- Liquidity: The stock market gives investors liquidity, enabling them to readily purchase and sell shares and offering an exit option for those wishing to cash out.
- By supplying cash to developing enterprises, the stock market facilitates economic expansion. These investments may contribute to greater productivity and economic growth.
- The stock market is sometimes regarded as a barometer of the general health of the economy. When the market is doing well, people may feel more confident spending and investing their money, which may contribute to more economic activity.
- Investing in the stock market via retirement accounts such as 401(k)s or individual retirement plans is a popular way for many individuals to save for their golden years (IRAs). Individuals may invest their funds in a variety of firms on the stock market, which can yield larger returns than a savings account or bond fund over the long run.

Although the stock market does not always follow a consistent pattern and market conditions can be influenced by factors such as interest rates, political events, and economic developments, the use of predictive analytics has for years encouraged traders to invest in the stock market and search for patterns.

The stock market, like many others, is subject to the basic principles of the theory of demand and supply. It asserts that the equilibrium between buyers and sellers in the market will determine the direction of a security's price. Investors are prepared to pay a higher price for a security when there is strong demand for it. Contrarily, when supply is plentiful but demand is weak, the price of a security will decline as sellers are ready to accept a lower price.

In this research, we will attempt to predict the future using two distinct methodologies. The utilisation of technical indicators comes first. Analysts use technical indicators to assess financial markets and

make trading choices. Frequently, they are used in combination with chart patterns and other kinds of technical analysis to assist traders in identifying trends, determining the strength of such trends, and making educated choices about the purchase and sale of shares.

There are several technical indicators available, each with its distinct properties and uses. Moving averages, Bollinger bands, and the relative strength index are examples of widespread technical indicators (RSI).

The second method is more probabilistic and is based on techniques for machine learning. We will forecast the market direction as (+1, -1) using Logistic regression, Gaussian Naive Bayes, Support Vector Machine (SVM), Random Forest, and the MLP classifier. These five machine learning methods are often used in classification tasks and can anticipate the market's direction (i.e., whether it will considerably rise or fall) as (+1, -1) values.

This paper intends to add to the current literature on stock market analysis by attempting to determine the statistical significance of regularly used market indicators to develop a "super indicator" that can anticipate stock movement.

In the sections that follow, we will evaluate the most popular technical indicators, determine the optimal combination of technical indicators, investigate machine learning techniques, and integrate them with our market indicator combinations.

The following sections contain extensive information about stock market analysis.

- Section 2: Information on the literature review, technical indicator calculations and how they work, and how the ML model works.
- Section 3: Information on the interpretation of these technical indicators and the several methods we've used to acquire our findings.
- Section 4: Analysis of the ML algorithm and combining them with our computed combination of technical indicators.
- Section 6: Limitations.
- Section 7: Conclusion.
- Section 8: References, which are used for this project.

3 Literature Review

This part will provide a comprehensive examination of key terms, technical indicators, and the machine learning algorithms used.

3.1 Key Market Terms

Here are some key market terms that will be used throughout this paper:

1. Stock: A stock is a share of ownership in a company. When purchasing a stock, you are purchasing a portion of the corporation.
2. Volatility: The degree to which the price of a stock or the market as a whole fluctuates over time.
3. Trend: A persistent movement in the price of a stock or the market as a whole over a period of time.

4. Risk: The possibility of losing money or incurring losses on an investment.

5. Return: The profit or loss earned on an investment.

6. Execution: Execution refers to the fulfilment of a stock order. For instance, you instruct your broker to purchase 100 shares of XYZ for USD10 a share. This order is executed when the deal is finished.

7. Bull market: A bull market is a period of rising stock prices, typically characterized by optimism and positive investor sentiment.

8. Bear market: A bear market is a period of falling stock prices, typically characterized by pessimism and negative investor sentiment.

9. Trading volume: The number of shares being traded at any time. More trading volume means more liquidity, and traders can more easily enter and exit positions.

10. Backtesting: It is the practice of determining the efficacy of a trading strategy by recreating its performance on previous data. This requires applying the approach to a dataset of historical price movements and assessing the findings to estimate the potential profitability and risk of the method. The objective of backtesting is to evaluate the strategy's dependability and robustness, as well as to uncover any possible flaws or restrictions. By studying the results of backtesting, traders may acquire useful insights into the prospective performance of a technical indicator technique and make educated judgements on whether or not to implement it in their trading strategy.

11. Buy call: A call option is a financial derivative that gives the holder the right, but not the obligation, to buy a specific asset (usually a stock) at a predetermined price (called the strike price) at any time before the option expires. When an investor buys a call option, they are essentially betting that the price of the underlying asset will rise in the future. For example, if an investor buys a call option on a particular stock with a strike price of USD50, and the stock is currently trading at USD40, the investor has the right to buy the stock for USD50 at any time before the option expires. If the stock's price rises above USD50, the investor can exercise their option to buy the stock at the lower strike price and sell it on the market for a profit. However, if the stock's price does not rise above USD50, the option will expire worthless, and the investor will lose the premium paid for the option. Buying a call option allows an investor to potentially profit from an upward movement in the price of the underlying asset while limiting their potential losses to the premium paid for the option. It is a bullish strategy that is often used as a way to hedge against potential losses in a portfolio.

12. Short selling: Short selling, also known as "shorting" or "selling short," is a trading strategy that involves selling a security that the trader does not own, with the expectation that the price will fall. The trader borrows the security from another investor and sells it on the market, hoping to buy it back at a lower price in the future. If the price does indeed fall, the trader can buy back the security at the lower price and return it to the lender, pocketing the difference as profit. For example, if a trader believes that the price of a particular stock is overvalued and is likely to fall, they might borrow shares of that stock and sell them on the market. If the stock's price does indeed fall, the trader can buy the shares back at the lower price and return them to the lender, making a profit. However, if the stock's price rises instead, the trader will have to buy the shares back at a higher price, resulting in a loss.

3.2 Technical Indicators

Technical indicators are statistical tools used to analyse the price and volume of a market or security. They are based on historical data and are designed to help traders spot patterns and trends that may suggest buying or selling opportunities. Technical indicators may be used in conjunction with fundamental analysis, which studies a company's financial facts and performance, to help investors make informed investment decisions. Technical indicators may be used in a variety of ways, including determining trend strength, probable entry and exit locations, and validating other technical or fundamental indications. Most commonly used technical indicators include:

3.2.1 Simple Moving Average

A simple moving average (SMA) is a kind of stock market indicator that is calculated by averaging the price of a security over a predetermined number of time periods. To get the simple moving average of a security, add the closing prices for a predetermined number of time periods and then divide by the number of time periods. For example, to calculate the 10-day moving average of a stock, you would add the closing prices for the prior 10 days and divide by 10. The result is the stock's average price for the preceding 10 trading days.

Simple moving averages are useful for identifying stock price trends and mitigating the effect of short-term price volatility. They may help investors decide whether to buy or sell assets depending on the market's overall trend.

$$SMA = \frac{A_1 + A_2 + ... + A_n}{n}$$

3.2.2 Exponential Moving Average

In financial analysis, an exponential moving average (EMA) is a kind of technical indicator that is used to smooth price data and make identifying patterns easier. It is calculated by allocating a larger weight to current prices and a lesser weight to prior prices, enabling the average to adapt more quickly to changes in the data.

Select a time interval, such as 10 days or 20 weeks, before computing the exponential moving average. Then, the closing price for each of the preceding N periods is weighted according to how recently it occurred. The most recent price will have the greatest weight, but the weight of each older price will decrease exponentially as you go farther back in time. Lastly, the exponential moving average is calculated by adding all weighted prices and dividing by the sum of all weights.

$$EMA_{Today} = (Value_{Today} \times (\frac{Smoothing}{1 + Days})) + EMA_{Yesterday} \times (1 - (\frac{Smoothing}{1 + Days}))$$

3.2.3 Relative Strength Index (RSI)

RSI is a technical indicator that assesses the strength of a security's price action. It is an indicator of momentum that compares the magnitude of recent gains to recent losses in order to identify overbought and oversold circumstances.

RSI is computed using a formula that compares the average of up closes against the average of down closes over a certain time period. The result is then charted on a scale from 0 to 100, with a rating over 70 suggesting an overbought market and a score below 30 indicating an oversold market.

Traders and investors often use the Relative Strength Index (RSI) to discover probable entry and exit points in an asset. If the RSI is over 70, for instance, traders may consider selling the asset, but if the RSI is below 30, traders may consider purchasing the security. It is essential to remember, however, that the RSI should not be utilised in isolation, but rather as part of a comprehensive trading strategy that also incorporates other technical and fundamental research tools.

$$RS = \frac{Avg.Gain}{Avg.Loss}$$

$$RSI = 100 - \frac{100}{1 + RS}$$

3.2.4 Moving Average Convergence Divergence (MACD)

Moving Average Convergence Divergence (MACD) is a technical indicator used to detect changes in a security's price trend. Subtracting the 26-period exponential moving average (EMA) from the 12-period EMA yields this value. The MACD line is then shown with a 9-period exponential moving average (EMA) of the MACD line, known as the "signal line."

On a chart, the MACD is often represented by two lines and a histogram. The MACD line represents the difference between the two EMAs, while the signal line is the MACD line's 9-period EMA. The difference between the MACD line and the signal line is the histogram. When the MACD line is above the signal line, it is a bullish indicator, and when it is below the signal line, it is a bearish signal.

MACD is often used to spot trend shifts and confirm trend strength and direction. Additionally, it may be used to detect future overbought or oversold market circumstances.

'slow' signal line — 12-period EMA of Price (fast) — 26-period EMA of Price (slow)

$$MACD_p = EMA_{12}(p) - EMA_{26}(p)$$

$$S_{MACD} = EMA_9(MACD)$$

'fast' signal line — 9-period EMA of MACD signal

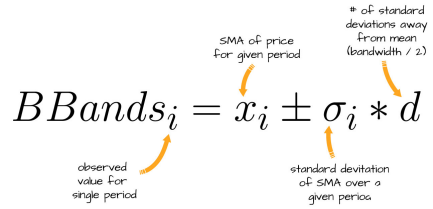
α

3.2.5 Bollinger bands

Bollinger Bands are a technical analysis technique developed in the 1980s by John Bollinger. They consist of three bands drawn in relation to the price of a securities. The centre band consists of a 20-period simple moving average. Both the top and lower bands are two standard deviations above and below the moving average, respectively.

Bollinger Bands may be used to detect probable overbought or oversold positions, as well as to measure a security's volatility. When the price is towards the top band, it may be overbought, and when it is near the lower band, it may be oversold. When the space between the bands expands, it may signal that volatility is growing, and when it narrows, it may indicate that volatility is decreasing.

Bollinger Bands may be used in any time range; however, daily charts are the most typical application.



$$BBands_i = x_i \pm \sigma_i * d$$

α

3.3 Machine Learning

Machine learning is a data analysis technique that automates the construction of analytical models. It is a field of artificial intelligence founded on the premise that computers can learn from data, recognize patterns, and make choices with minimal human input. There are three main types of machine learning:

1. Supervised Learning: The algorithm is trained on a labelled dataset for which the right output is already known. The algorithm learns the right mapping between input and output. This method is used for classification and regression applications.
2. Unsupervised Learning: The algorithm is not provided with any labelled data and must detect patterns and correlations in the input data on its own. This learning method is used for clustering and dimensionality reduction.
3. Reinforcement Learning: The algorithm acquires knowledge via trial-and-error interactions with a dynamic environment. It is used in control systems and video game engines.

Additionally, there are some other subtypes of machine learning, such as semi-supervised learning, active learning, and transfer learning.

On our data sets, we will utilise supervised machine learning methods. Techniques such as Logistic Regression, Gaussian Naive Bayes, Support Vector Machine, Random Forest, and MLP (Multilayer Perceptron Perceptron Classifier).

3.3.1 Logistic Regression

Logistic regression is a type of statistical analysis used to predict a binary outcome (1 / 0, Yes / No, True / False) given a set of independent variables.

3.3.2 Gaussian Naive Bayes

Gaussian Naive Bayes is a classification algorithm based on Bayes' Theorem, which is used for binary and multi-class classification problems.

3.3.3 Support Vector Machine (SVM)

SVM is a linear model for classification and regression problems. It is used for classification of complex but small or medium-sized datasets.

3.3.4 Random Forest

Random Forest is an ensemble learning method for classification and regression. It consists of a number of decision trees, and it outputs the class that is the mode of the classes output by individual trees.

3.3.5 MLP Classifier

MLP stands for Multi-Layer Perceptron, which is a type of feedforward artificial neural network. It is used in supervised learning for classification problems.

4 Approaches to make the decision

This section will examine the importance of the technical indicators. In addition, we will see how it helps us analyse the present trend and anticipate the future trend of the stock market in relation to the stock we are examining.

It's true that there isn't a magic indicator that can guarantee profits for every possible investment. Using a variety of indicators allows for a more full and accurate view of the market since various indicators perform better for different stock kinds and market situations.

Backtesting is the process through which a trader or investor tests and evaluates a trading strategy using historical data. To run backtests, we will use the Python libraries backtesting.py and backtrader.py.

In our backtesting, we will compute the indicators based on the closing price and buy based on the price of the next open candle.

Backtesting a trading strategy may lead to look-ahead bias, also known as survivorship bias. It occurs when a trading strategy is tested using historical data and has access to future data during transaction execution. This may result in an overestimation of the strategy's performance since the uncertainty that arises during actual execution is not accounted for.

To counteract lookahead bias, the backtesting.py package offers an event-driven backtesting engine. This means that the strategy's trades are executed only under certain conditions and based only on the information available at the time the conditions are satisfied. This strategy mimics how transactions would be conducted in the real world, hence decreasing the look-ahead bias.

In addition, they provide the option of dividing the data into a train set and a test set, which may be used to evaluate the strategy on fresh data in a manner similar to machine learning testing. By making the test more realistic, the introduction of slippage and transaction costs improves the accuracy of the trading strategy.

These backtesting libraries provide a simple technique for testing and assessing your algorithmic trading strategies without the need to construct a complex backtesting infrastructure.

To maximize the returns of a trading strategy based on an indicator, the backtesting framework's optimise() function may be used. Typically, the function would operate by accepting a set of starting parameter values for the indicator (such as the window size) and historical market data, and then simulating the trading method using various parameter combinations.

In this paper, the fitness function would be constructed to maximize the strategy's returns. The optimise() function's optimization method would then repeatedly alter the parameter values and reevaluate the fitness function until it found the parameter combination that yields the maximum returns using our strategy.

In this research, we will assume that all companies trading on the global stock exchanges in the same

sector display similar behaviour, which is why I have examined stock indices from across sectors.

In this research, we will presume that all firms trading in the same sector on global stock exchanges exhibit identical behaviour, which is why I have chosen to analyse leading worldwide stock indices.

4.1 About the data set

I selected ten years of data from the Yahoo Finance API, beginning on January 1, 2013 and ending on January 1, 2023. These are the leading indexes chosen:

1. SP 500 (GSPC): The SP 500 is an index of 500 large-cap companies often regarded as a leading indicator of U.S. stocks. A committee at Standard Poor's selects and weights the companies in the index based on their market capitalization, which is the total value of a company's shares. The index is regarded as a wide, varied representation of the U.S. stock market and is used as a performance benchmark for the whole market.

   The SP 500 is closely watched by global investors and market experts and is regarded as one of the most significant stock market indexes. It is a capitalization-weighted index, therefore firms with greater market capitalization have a greater weight in the index. This makes the index more susceptible to the performance of established, major corporations. The index is regarded as the standard for large-cap U.S. companies, and its fluctuations are constantly monitored as a measure of the health of the U.S. stock market as a whole.

2. Dow 30 (DJI):

   The Dow 30, often known as the Dow Jones Industrial Average (DJIA), is an index of 30 of the biggest publicly listed firms in the United States. The index is computed based on the stock prices of the firms in the index and is designed to provide a broad indication of the overall performance of the stock market. The Dow 30 firms are among the most frequently owned and actively traded equities in the United States. Microsoft, Apple, Amazon, Coca-Cola, and Boeing are among the firms now included in the Dow 30.

3. NASDAQ Composite Index (IXIC):

   The NASDAQ Composite Index, often known as the NASDAQ or the NASDAQ-100 Index, is a stock market index comprised of all common stocks and comparable securities listed on the NASDAQ stock exchange. The NASDAQ Composite is a broad-based index that consists of over 3,000 stocks of firms from a variety of industries, with the technology and consumer services sectors being the majority. The NASDAQ Composite is often used as a performance benchmark for technology-heavy portfolios and is one of the most extensively watched indexes worldwide.

4. The NYSE Composite Index (NYA):

   The NYSE Composite Index, commonly referred to as the Dow Jones Composite Index, is an index of all common stocks listed on the New York Stock Exchange (NYSE). The index encompasses about two-thirds of the NYSE's market capitalization and is a broad-based index that includes firms from a variety of industries, including financial, industrial, technology, and consumer products. The index is frequently tracked by investors and market experts as a measure of the New York Stock Exchange's performance as a whole. The index created based on the prices of the stocks in the index is a value-weighted index, which implies that the bigger a company's market capitalization, the more effect it has on the index value.

5. NYSE AMEX COMPOSITE INDEX (XAX):

   The NYSE American Composite Index is an index of all common stocks listed on the NYSE American (formerly known as American Stock Exchange, or AMEX). The NYSE American Composite Index is a wide index that includes small- and mid-cap firms among its constituents. It attempts to offer a complete performance benchmark for NYSE American-listed firms. It is a value-weighted index, therefore the larger a company's market capitalization, the bigger impact it has on the index's value. The NYSE American Composite Index is not as extensively watched as the NYSE Composite

or the NASDAQ Composite, but it remains a significant indicator of the NYSE American market's success.

6. Cboe UK 100 (BUK100P):

   CBOE UK 100 is an index created and produced by the Chicago Board Options Exchange (CBOE). It is based on the FTSE 100 index, which is a stock market index comprised of the 100 most heavily capitalised and frequently traded UK businesses listed on the London Stock Exchange (LSE). The FTSE 100 is regarded as a measure of the success of the UK stock market, and its constituent firms are among the biggest and most stable in the country. The CBOE UK 100 index attempts to replicate the performance of the FTSE 100 in order to provide investors with a benchmark for the UK stock market. The Cboe UK 100 options contract is used to get exposure to the UK stock market or to hedge related risks.

7. Russell 2000 (RUT):

   The Russell 2000 Index is a stock market index that tracks the performance of the 2,000 smallest firms included in the Russell 3000 Index, which comprises the 3,000 biggest publicly listed companies in the United States. The Russell 2000 is a benchmark for small-cap companies and measures the performance of the small-cap portion of the U.S. equity market. The Russell 2000 is a market capitalization-weighted index, thus the firms with the biggest market capitalizations have the most impact on the index's value. The Russell 2000 is noted for its liquidity, depth, and diversity, since it is comprised of firms from diverse sectors and industries. The Russell 2000 is rebalanced yearly to ensure that it represents the small-cap section of the U.S. stock market appropriately. As a gauge of the performance of small cap companies on the US stock market, the index is closely monitored by investors, market analysts, and financial professionals.

8. The CBOE Volatility Index (VIX):

   The CBOE Volatility Index (VIX) is a measure of the implied volatility of the SP 500 index. The VIX is sometimes referred to as the "Fear Index" or the "Fear Gauge" because it is often used as a measure of market sentiment or to indicate how volatile the stock market is expected to be in the future. It is calculated by the Chicago Board Options Exchange (CBOE), using the prices of options on the SP 500. VIX is calculated from real-time prices of SP 500 index options, more specifically SP 500 at-the-money and out-of-the-money options, then VIX is transformed into an annualized volatility index. A higher VIX value indicates that the market is expected to be more volatile in the near future, while a lower VIX value indicates that the market is expected to be less volatile. It is widely used as a benchmark for risk level perception of US equity market by investors, traders and market analysts.

9. FTSE 100 (FTSE):

   The FTSE 100 Index (FTSE 100) is an index of the 100 largest and most frequently traded firms listed on the London Stock Exchange (LSE). The FTSE 100 is regarded as a measure of the success of the UK stock market, and its constituent firms are among the biggest and most stable in the country. The FTSE 100 is a market capitalization-weighted index, thus the firms with the biggest market capitalizations have the most impact on the index's value. The FTSE 100 includes corporations from several sectors and industries, such as banking, energy, mining, healthcare, and consumer products. Quarterly rebalancing ensures that the FTSE 100 continues to appropriately reflect the performance of the top firms in the UK. As a gauge of the performance of the UK equities market, the index is closely monitored by investors, market analysts, and financial professionals.

10. The DAX Performance-Indicator (GDAXI):

    The DAX Performance-Indicator (GDAXI) is an index measuring the performance of the 30 biggest and most liquid German firms listed on the Frankfurt Stock Exchange. The firms are chosen in accordance with their market capitalization and liquidity. The index was launched in 1988 and is compiled by Deutsche Borse AG, the operator of the German stock market. The DAX is regarded as a performance benchmark for the German economy and is extensively used as a performance benchmark for German equity funds. It serves as a benchmark for index-linked investment products such exchange-traded funds (ETFs) and index-linked structured products.

5 Analysis

5.1 Technical indicators

5.1.1 Simple Moving Average

:

We employ a crossover strategy based on simple moving averages. Whenever a company's current trading price is trading above a set SMA, it indicates that demand for the stock is comparatively greater than supply. Therefore, the stock's current trend will be bullish. In contrast, if the current trading price is below the specified SMA, it indicates that sellers are in control of the market. Therefore, the present trend will be bearish. To initiate judgments based on SMA, we adopted the following strategy.

When the selected lower SMA crosses over the higher SMA, we may be certain of a trend reversal. If the present trend is bullish and a lower crossing occurs, the future trend will be bearish compared to the point of crossover. In our present method, anytime a lower crossing occurs, a short-selling decision is triggered. If an upper crossing occurs, the buy decision is triggered.

```
class SmaCross(Strategy):
    # Define the two MA lags as *class variables*
    # for later optimization
    n1 = 10
    n2 = 20

    def init(self):
        # Precompute the two moving averages
        self.sma1 = self.I(SMA, self.data.Close, self.n1)
        self.sma2 = self.I(SMA, self.data.Close, self.n2)

    def next(self):
        # If sma1 crosses above sma2, close any existing
        # short trades, and buy the asset
        if crossover(self.sma1, self.sma2):
            self.position.close()
            self.buy()

        # Else, if sma1 crosses below sma2, close any existing
        # long trades, and sell the asset
        elif crossover(self.sma2, self.sma1):
            self.position.close()
            self.sell()
%%script echo

    def next(self):
        if (self.sma1[-2] < self.sma2[-2] and
                self.sma1[-1] > self.sma2[-1]):
            self.position.close()
            self.buy()

        elif (self.sma1[-2] > self.sma2[-2] and
              self.sma1[-1] < self.sma2[-1]):
            self.position.close()
            self.sell()
```

Index Name	Ticker Name	Lower SMA	Higher SMA	Number of trades	Return Percentage
S&P 500	^GSPC	20	60	42	13.763484
Dow 30	^DJI	5	15	183	14.254334
NASDAQ	^IXIC	15	30	89	32.338281
NYSE	^NYA	25	40	60	3.90733
NYSE Amex	^XAX	10	30	85	114.932995
Cboe UK 100	^BUK100P	15	25	109	-45.214918
Russell 200	^RUT	20	25	135	23.002412
Cboe Volatility	VIX	20	25	35	179.156129
FTSE 100	^FTSE	15	25	121	-48.420638
Dax Performance	^GDAXI	20	35	70	10.378058

When we reviewed Table's data, we discovered that we are unable of making very precise judgements. After locating the crossing point, we did not wait for a trend reversal confirmation before making these mistakes. The returns on each stock are inconsistent; hence, this strategy is inferior than the buy-and-hold approach.

5.1.2 Exponential moving average

Here, we will once again apply a crossover technique based on exponential moving averages (EMAs) to identify potential buy or sell signals in a stock or other financial instrument.

The approach involves comparing two separate EMAs, one with a shorter time period and one with a longer time period, and searching for occasions in which the shorter EMA "crosses over" or "crosses under" the longer EMA.

When the shorter EMA rises above the longer EMA, this is considered a bullish indicator and a possible buy signal. In contrast, a "crossunder" happens when the shorter EMA goes below the longer EMA, which is seen as a bearish indicator and a possible sell signal.

```
class EmaCrossStrategy(Strategy):

    # Define the two EMA lags as *class variables*
    # for later optimization
    n1 = 5
    n2 = 10

    def init(self):
        # Precompute two moving averages
        self.ema1 = self.I(EMA_Backtesting, self.data.Close, self.n1)
        self.ema2 = self.I(EMA_Backtesting, self.data.Close, self.n2)

    def next(self):
        # If ema1 crosses above ema2, buy the asset
        if crossover(self.ema1, self.ema2):
            self.position.close()
            self.buy()

        # Else, if ema1 crosses below ema2, sell it
        elif crossover(self.ema2, self.ema1):
            self.position.close()
            self.sell()
```

Index Name	Ticker Name	Lower EMA	Higher EMA	Number of trades	Return Percentage
S&P 500	^GSPC	20	60	29	54.479539
Dow 30	^DJI	25	50	40	-13.012466
NASDAQ	^IXIC	5	30	103	71.937946
NYSE	^NYA	15	40	58	-14.834524
NYSE Amex	^XAX	5	10	207	49.709252
Cboe UK 100	^BUK100P	10	15	140	-67.477459
Russell 200	^RUT	10	40	75	-8.669518
Cboe Volatility	VIX	10	40	25	149.893322
FTSE 100	^FTSE	5	55	106	-57.696275
Dax Performance	^GDAXI	10	20	107	-7.708459

Similarly to the SMA method, the EMA strategy's returns are inconsistent among indices; hence, this strategy is inferior than the buy-and-hold approach.

5.1.3 RSI oscillator

Again, we will use a crossover technique based on the oscillator for the relative strength index (RSI) and the simple moving average (SMA):

(a) Calculate the relative strength index (RSI) for a certain time (for instance, 14 days) for a stock or other financial instrument.

(b) Calculate a SMA for the time in question.

(c) Determine the crossover point, such as when the RSI crosses over the SMA.

(d) Purchase the musical instrument.

(e) Wait for a subsequent crossing moment, such as when the RSI crosses below the SMA.

(f) Sell.

This technique is predicated on the notion that when the RSI crosses above the SMA, it is a positive signal signalling that the price of the stock is likely to increase. In contrast, a bearish signal is generated when the RSI crosses below the SMA, suggesting that the price of the stock is likely to decline. The technique tries to capitalize on these short-term price patterns by purchasing when the RSI goes above the SMA and selling when it falls below the SMA.

```python
def SMA(array, n):
    """Simple moving average"""
    return pd.Series(array).rolling(n).mean()

def RSI(array, n):
    """Relative strength index"""
    # Approximate; good enough
    gain = pd.Series(array).diff()
    loss = gain.copy()
    gain[gain < 0] = 0
    loss[loss > 0] = 0
    rs = gain.ewm(n).mean() / loss.abs().ewm(n).mean()
    return 100 - 100 / (1 + rs)
```

```python
class System(Strategy):
    d_rsi = 30  # Daily RSI lookback periods
    w_rsi = 30  # Weekly
    level = 70

    def init(self):
        # Compute moving averages the strategy demands
        self.ma10 = self.I(SMA, self.data.Close, 10)
        self.ma20 = self.I(SMA, self.data.Close, 20)
        self.ma50 = self.I(SMA, self.data.Close, 50)
        self.ma100 = self.I(SMA, self.data.Close, 100)

        # Compute daily RSI(30)
        self.daily_rsi = self.I(RSI, self.data.Close, self.d_rsi)

        # To construct weekly RSI, we can use `resample_apply()`
        # helper function from the library
        self.weekly_rsi = resample_apply(
            'W-FRI', RSI, self.data.Close, self.w_rsi)


    def next(self):
        price = self.data.Close[-1]

        # If we don't already have a position, and
        # if all conditions are satisfied, enter long.
        if (not self.position and
            self.daily_rsi[-1] > self.level and
            self.weekly_rsi[-1] > self.level and
            self.weekly_rsi[-1] > self.daily_rsi[-1] and
            self.ma10[-1] > self.ma20[-1] > self.ma50[-1] > self.ma100[-1] and
            price > self.ma10[-1]):

            self.buy()

        elif price < self.ma10[-1]:
            self.position.close()
```

Index Name	Ticker Name	Daily RSI	Weekly RSI	level	Number of trades	Return Percentage
S&P 500	^GSPC	15	10	70	10	7.467481
Dow 30	^DJI	30	10	70	5	12.774482
NASDAQ	^IXIC	30	30	60	56	14.282937
NYSE	^NYA	30	30	60	29	15.754879
NYSE Amex	^XAX	30	30	60	19	14.787541
Cboe UK 100	^BUK100P	30	30	60	3	-0.141674
Russell 200	^RUT	20	10	70	5	4.871878
Cboe Volatility	VIX	30	30	30	2	2.008
FTSE 100	^FTSE	10	10	70	1	0.151885
Dax Performance	^GDAXI	15	10	60	39	6.7831

This technique nearly always produces positive returns, although it is inferior to the buy-and-hold approach.

5.1.4 MACD

MACD (Moving Average Convergence Divergence) crossover is a technical analysis indicator used to detect changes in the trend direction of a stock. The technique calls for the use of two distinct moving averages, one with a shorter time period (the "fast" line) and one with a longer time period (the "slow" line) (the "slow" line).

When the fast line crosses over the slow line, it is an indication that the stock's price may climb. When the fast line crosses below the slow line, a bearish signal is generated, suggesting that the stock's price may decline.

This approach is commonly used by traders, is straightforward, and can be implemented in several ways. We will act on the crossings, purchasing when the fast line passes above the slow line and selling (or going short) when it crosses below.

```
def MACD(close, n1, n2, ns):
    #n1-n2
    macd, macdsignal, macdhist = ta.MACD(close, fastperiod=n1, slowperiod=n2, signalperiod=ns)
    return macd, macdsignal

class MACDCross(Strategy):
    n1 = 12
    n2 = 26
    ns = 9

    def init(self):
        self.macd, self.macdsignal = self.I(MACD, self.data.Close, self.n1, self.n2, self.ns)

    def next(self):
        if crossover(self.macd, self.macdsignal):
            self.buy()
        elif crossover(self.macdsignal, self.macd):
          self.position.close()
```

Index Name	Ticker Name	N1	N2	NS	Number of trades	Return Percentage
S&P 500	^GSPC	90	270	35	16	18.11156
Dow 30	^DJI	70	200	35	16	14.459729
NASDAQ	^IXIC	50	120	40	23	27.935451
NYSE	^NYA	90	270	45	12	15.317304
NYSE Amex	^XAX	30	260	15	30	55.226042
Cboe UK 100	^BUK100P	90	290	45	16	-26.709853
Russell 200	^RUT	80	280	20	18	19.170254
Cboe Volatility	VIX	90	280	45	1	63.256181
FTSE 100	^FTSE	90	250	45	15	-23.885953
Dax Performance	^GDAXI	50	270	45	15	28.137727

5.2 Machine Learning

For our machine learning algorithms:

(a) Downloading the daily closing price data using the yfinance python module, calculating daily log returns, and deriving market direction based on this information.

(b) Then We will generate feature variables to forecast the direction of the market. As a first stage, we will utilise five lags of the log-returns series and digitise them as binary (0, 1) to estimate the chance of an upward and a downward market movement as (+1, -1) respectively. Compute five days of lagging returns and adjust the returns series by the number of delays to match them with the forward return for one day. Define the function to convert lag returns to binary (0,1) numbers using the np.digitize function ().

(c) Now we will forecast the market direction as (+1, -1) using Logistic regression, Gaussian Naive Bayes, Support Vector Machine (SVM), Random Forest, and MLP Classifier.

(d) Then, using vectorized backtesting, we will assess the performance of each of these models and show the cumulative returns. Accordingly, we will:

i. Develop a dictionary of chosen algorithms. Define a function that fits all models for where the direction column is the dependent variable and the bin columns are the feature variables.
ii. Define a function that predicts all position values based on the models that have been fitted.
iii. Define an evaluation function for all trading strategies. Next, we fit the models, forecast positions, and assess all trading strategies by multiplying anticipated directions by daily actual returns.
iv. Determine the total return and standard deviation for each investment plan.
v. Determine the number of transactions over time for the strategies with the greatest and second-highest returns.
vi. Then the backtesting of the generated trading methods is vectorized, and the performance over time is shown.

(e) Then, using the Python package Backtrader, we will do backtesting on the model with the highest performance, namely support vector machine (SVM). The approach for backtesting will be as follows:
i. We begin with an initial investment of USD100,000 and a 0.1 percent trading fee.
ii. When the expected value is +1, we purchase, and when it is -1, we sell (if the stock is in our possession).
iii. All-in technique – while placing a purchase order, acquire the maximum number of shares available.
iv. Short selling is prohibited.

(f) Next, the SignalData and Cerebro objects are instantiated, and the pricing dataframe, ML-Strategy, starting capital, commission, and pyfolio analyzer are added. We then do the backtest and record the results.

(g) Perform analysis of back-testing :
i. From the backtesting result, we extract inputs required by pyfolio.
ii. Compare and contrast the benchmark daily returns with the approach.
iii. Obtain strategy performance data using pyfolio's show perf stats function.
iv. Visualize drawdowns, cumulative returns, the undersea plot, and the Sharpe ratio on a rolling basis.

5.2.1 Analysis

For GSPC (similarly we perform our analysis on all the indices)

(a) Machine Learning Table:

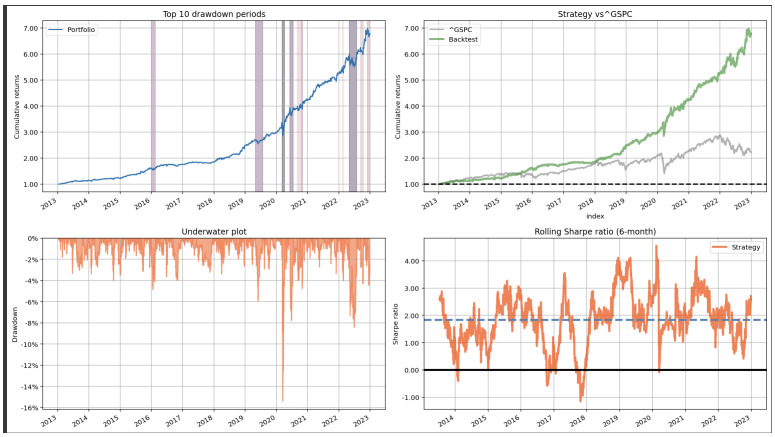
```
Total Returns:
returns                  2.627959
strategy_log_reg         2.585266
strategy_gauss_nb        1.319339
strategy_svm             8.370439
strategy_random_forest   6.771996
strategy_MLP             8.520519
dtype: float64

Annual Volatility:
returns                  0.176625
strategy_log_reg         0.176628
strategy_gauss_nb        0.173980
strategy_svm             0.176219
strategy_random_forest   0.176316
strategy_MLP             0.176211
dtype: float64
```

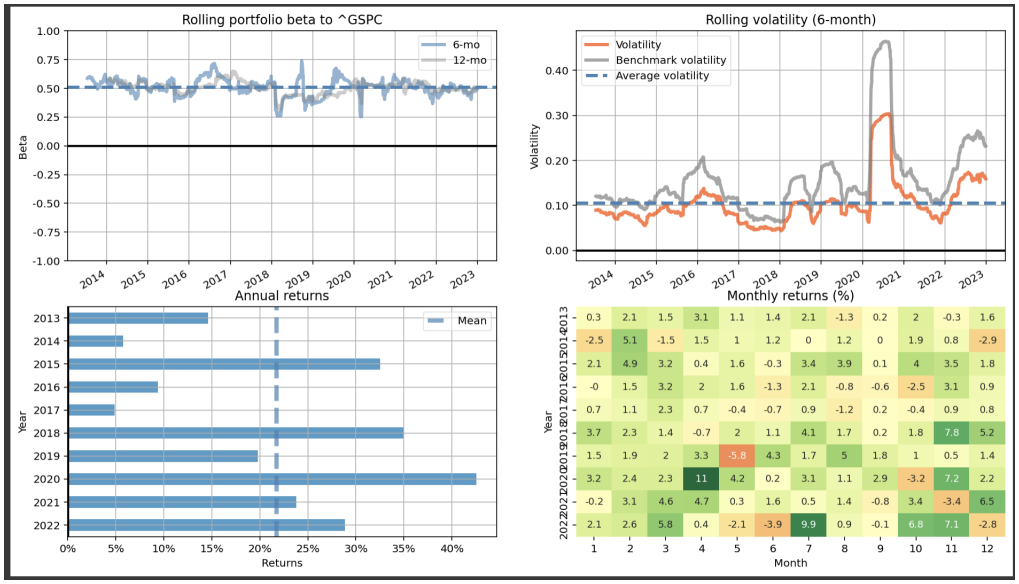
```
# number of trades over time
print('Number of trades SVM = ', (stock['pos_svm
print('Number of trades Ramdom Forest = ',(stock
print('Number of trades Logistic regression = '
print('Number of trades Gaussian Naive Bayes = '
print('Number of trades MLP = ',(stock['pos_MLP'

Number of trades SVM =  1151
Number of trades Ramdom Forest =  1151
Number of trades Logistic regression =  379
Number of trades Gaussian Naive Bayes =  886
Number of trades MLP =  1151
```

(b) Backtesting using SVM:

Start date	2013-01-10
End date	2022-12-30
Total months	119
	Backtest
Annual return	21.168%
Cumulative returns	578.015%
Annual volatility	11.856%
Sharpe ratio	1.68
Calmar ratio	1.38
Stability	0.97
Max drawdown	-15.386%
Omega ratio	1.48
Sortino ratio	2.59
Skew	-0.89
Kurtosis	35.00
Tail ratio	1.38
Daily value at risk	-1.415%

(c) Graphs:





Our annual return is 21.168 percent and cumulative return is 578.015 percent. This beats the simple buy and hold strategy annual return.

5.3 Combine Machine Learning and Technical Indicator

(a) Feature Engineering: In addition to the five-day lagging returns utilised earlier, let's use a few other technical indicators, such as the RSI (Relative Strength Index), Bollinger Bands, and Moving Average Convergence Divergence (MACD) indicator. I used the ta-lib Python module to compute the technical indicators.

(b) We will utilise an API for Keras and TensorFlow to create a deep neural network model. Our strategy is API hunting, which entails determining what and how to utilise the API rather than providing a mathematical explanation. Refer to link¿ for further information on Keras and TensorFlow.

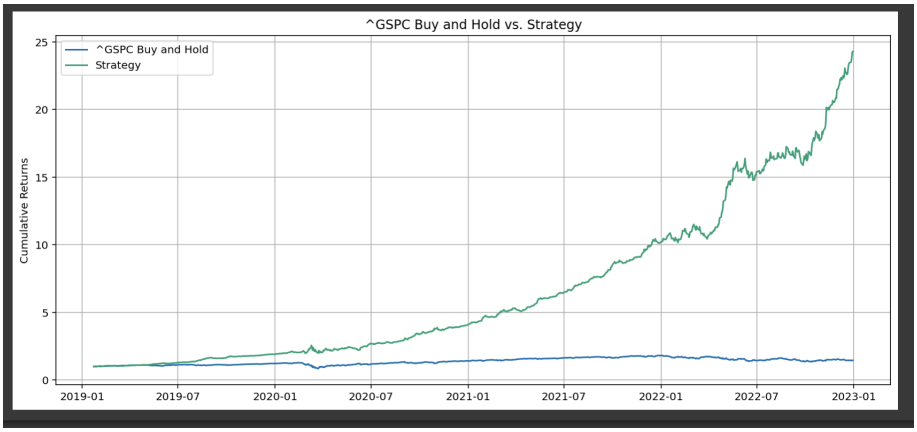
(c) Now, based on our forecast, we will compute the portfolio position and return for the strategy and illustrate the cumulative buy-and-hold returns against the strategy returns.

(d) Now we will backtest our strategy using backtrader similar to out previous analysis.

5.3.1 Analysis

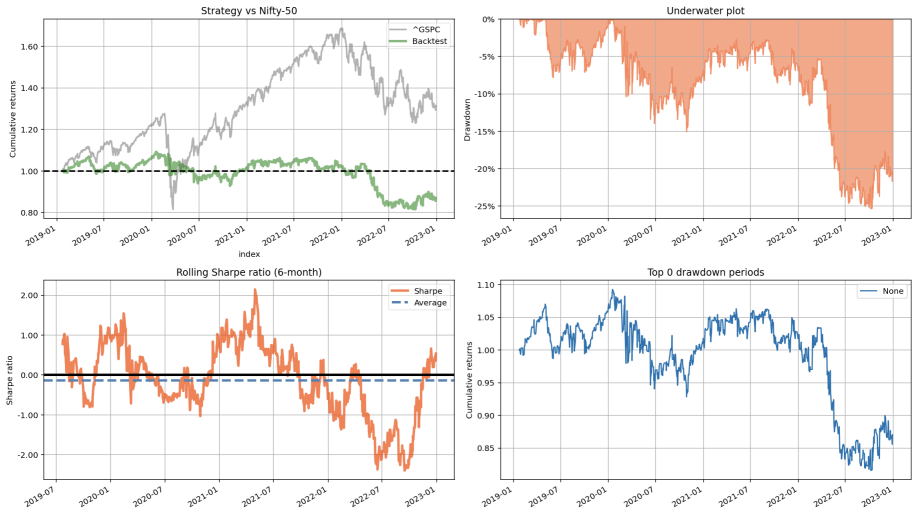
(a) The result is extremely stunning. Our strategy's overall return is many times that of the buy-and-hold strategy.

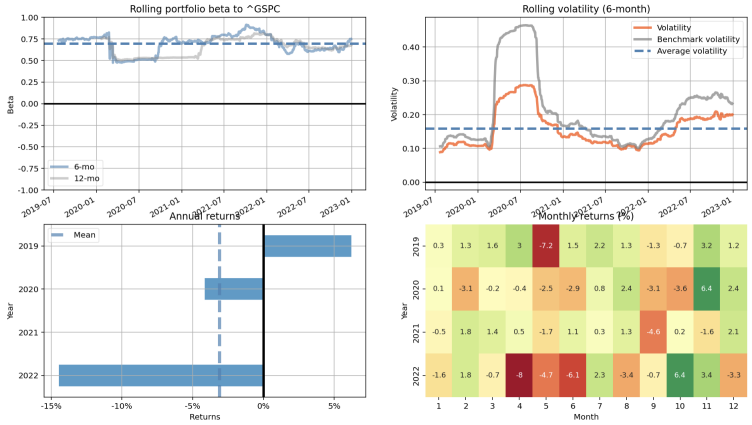
```
Total Returns:
returns              1.458278
strategy_return     24.290332
dtype: float64

Annual Volatility:
returns             0.230363
strategy_return     0.224734
dtype: float64
```



(b) Backtesting Results: Let's evaluate the effectiveness of our plan. In contrast to the return seen during vectorized backtesting, both the yearly and cumulative returns are negative. If we analyse a few more criteria, we can see that 'no short selling' and trading fees have negatively affected the performance of our method.

Start date	2019-01-23
End date	2022-12-29
Total months	47
	Backtest
Annual return	-3.463%
Cumulative returns	-12.967%
Annual volatility	16.715%
Sharpe ratio	-0.13
Calmar ratio	-0.14
Stability	0.38
Max drawdown	-25.363%
Omega ratio	0.97
Sortino ratio	-0.17
Skew	-0.36
Kurtosis	7.17
Tail ratio	0.83
Daily value at risk	-2.114%





6 Limitations

(a) 1. In all the ways covered in this report, we assumed that anytime we wish to make a transaction, we can locate someone willing to engage in that deal with us, and we get the shares we want. Not true for trading in real time. To acquire a deeper understanding of the behaviour of our techniques, we must compare these models to real-time data.

(b) For purposes of comparison, we have selected stocks from diverse industries. However, the behaviour of these indicators may differ for other members of the sectors from which the stocks were selected.

(c) We have solely analysed information from the Indian stock market. The behaviour of these models may vary if foreign stocks are included. This constraint is attributable to the sentiments connected with investors.

(d) In the absence of significant stock market volatility, these indicators may not be able to anticipate any trends. This circumstance occurs when all potential investors are awaiting the company's performance before investing.

(e) This study included the analysis of static data. The prices on the real-time stock market fluctuate every millisecond. As a result, the choice taken at the present instant may not be applicable in the next instant because the trend has shifted as a result of the preceding transaction. This difficulty cannot be resolved until the method is analysed using real-time data.

(f) All equities studied were based on information ranging from 2013 to 2022. When fresh data are added to the model, its precision may change.

7 Ethics

This project provides all materials for research purposes only, with no obligations or particular advice for action. It is not investment advice and cannot be substituted for it. Before engaging in certain transactions and investments, it is advised to consult with a personal financial counselor. One should only engage in such transactions if they have a comprehensive awareness of the nature of the contracts (and contractual relationships) they are engaging in, as well as their risk potential.

Many people are not good candidates for trading futures, options, forex, CFDs, stocks, cryptocurrencies, and other similar financial products. You should think carefully about whether trading is right for you based on your experience, goals, financial situation, and anything else that is relevant. Historical performance is not indicative of future outcomes. In the content that can be seen, there is no request to trade in any financial instruments or securities. Trading carries with it a potentially significant risk of loss. So, you should look at your finances and, if necessary, talk to a professional to find out if your personal and financial situation allows you to trade and if you are willing to take the high risk of a loss. If you, a broker, or a commercial advisor sets contingent orders, like a "sto

p loss" or "stop-limit" order, these orders may not limit your losses to the amount you expected because market conditions may make it impossible to do so.

In addition, trading involves the use of leverage, which may work for or against you. Using these effects of leverage can lead to either huge trading losses or huge trading gains. The trades and developments shown in this project are based only on hypothetical and simulated transactions, minimizing their visual impairment. These results do not represent actual transactions, as would be the case with a real checking account. The results may be too high or too low depending on market conditions, such as a lack of liquidity since the transactions shown haven't happened yet.

Because of this, it is hard to tell if something will happen in the same or a similar way in the future. This project is not meant to provide investment advice. It is not meant to substitute for expert financial counsel. Trading has the potential to be addicting. Please seek professional assistance if you're in trouble. Accept that you have to get legal advice about your property and know everything there is to know about the risks and benefits of trading. Before making any investment decisions, please consult your financial advisor.

8 Conclusion and future work

Predicting the stock market is a difficult undertaking that is impacted by several variables, such as economic circumstances, corporate performance, and world events. Others may not have the same degree of success as other investors in forecasting market movements. Before making investing selections, it is essential to perform research and consult with financial experts due to the volatility of the stock market.

During our investigation, we determined that our strategies performed differently on various equities owing to the fact that indicators and machine learning algorithms behave differently across markets. While calculating returns, we have additionally accounted for the fee charged on each transaction, which has reduced the overall return compared to a basic buy-and-hold strategy. This was done to recreate the original market conditions.

For further research It is crucial to observe the correlation between different periods in every single sort of trade. For instance, if daily interval suggests a decline, intraday will imply a short-term positive trend. Nonetheless, the opposite is not true.

In conclusion, stock market analysis is a crucial aspect of investing in the stock market. It involves evaluating various economic, financial, and company-specific factors to predict future stock prices and market trends. However, due to the complex and dynamic nature of the stock market, it can be challenging to accurately predict market movements. Therefore, it is important to conduct thorough research, seek advice from financial professionals, and diversify your investments to minimize risk. Additionally, investors should also have a long-term perspective and not get swayed by short-term market fluctuations.

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10 Appendix: Proposal

Are any of the "Harry Potter" indicators, better than Machine learning alogrithms for stock market analysis? Sachin Sharma September 2021

Research Proposal

11 Aim

This research tries to determine whether "Harry Potter" indications, such as Fibonacci retracement tools, have statistical importance in long-term stock market analysis, and then use that study to construct a super indicator to compare it with machine learning algorithms which is an artificial neural network used in the fields of artificial intelligence and deep learning. Unlike standard feed-forward neural networks. Many economists and social scientists have long sought to forecast the stock market. It is often considered that the stock market is a fool's game because it is ultimately a random process. Price predictions are difficult to make in the stock market since there are so many moving parts. Many people think it's a good idea to study and predict stock prices using machine learning methods and other algorithms. This study employs two ways to predict the future. The usage of multiple technical indicators is one example. These technical indicators are used to forecast changes in the patterns of the stock market. Technical indicators are mathematical calculations that can be applied to a stock's price, volume, or even another technical indicator. Technical indicators' deterministic character will provide reliable evidence for stock market forecasting. This use of technical indicators for stock market forecasting enhances predictability. The second methodology is a probabilistic method based on the LSTM Model. This notion is more applicable to dynamic systems and has been extensively applied to pattern recognition problems. It is based on statistical methods and is capable of handling new data correctly. In this method, two datasets are interpolated using price components from their nearest neighbours, based on past datasets that complement the current stock price behaviour. This leads to a forecast of the stock price trend of the variable of interest for tomorrow.

12 Objective

The objectives of this study are:

(a) Be familiar with all of the stock market's essential terminologies.

(b) To analyze and evaluate the importance of the most commonly used technical indicators.

(c) Compute the ideal mix of technical indicators.

(d) Examine the neural network and machine learning and compare it to the typical market indicator combination.

13 Problem

The stock market remains a fascinating and challenging topic for analysis and forecasting. As more data becomes available, it becomes harder to collect and process it to find information and figure out how it affects stock prices. Some challenges are live testing, algorithmic trading, long-term forecasting that doesn't work, and analyzing the sentiment of business filings. Most of the literature on stock analysis and prediction says that the offered methods can be used to make money on the stock market in real-time. While an algorithm may perform well during back testing under controlled conditions, live testing is extremely difficult due to the presence of multiple variables such as price swings and noise.

The functioning of the stock market has been affected by algorithmic trading technologies. The majority of trading in equity futures is done by computers, not by people. Even though algorithmic

trading has benefits like lower costs, less latency, and less reliance on market sentiment, it also makes things harder for regular investors who don't know how to build these systems. Today, these methods often cause panic selling, which causes markets to overreact. Consequently, market behavior becomes more difficult to evaluate. As new algorithms keep coming out every day, it gets harder to compare how well they work and how accurate they are.

14 Data

This project will use market data, which is the transmission of trade-related information in real time. It contains various information, such as price, bid/ask quotes, and market volume. Traders look at the value of different assets and use market data to figure out how to buy and sell. The goa l of using market data is to find out as much as possible about the asset you want to trade to determine how risky the market is and how live news will affect it. The data set doesn't have any information that could be used to find out who someone is, like their name, address, account number, social security number, or any other supporting documents.

15 Proposed Methodology

(a) First, we'll look at all the terms, technical indicators, and LSTM models in detail.

(b) Then we will examine the significance of the technical indicators. We will also look at how it helps us analyze current trends and predict future trends in the stock market as they relate to the stocks we are looking at.

(c) This will allow us to determine the optimal combination of indicators that may be utilized to improve the accuracy of our model.

(d) Then, this model will be compared to an artificial neural network and machine learning.

16 limitations

limitations:

(a) We assume that if we wish to make a deal, we can locate someone prepared to engage in that trade with us, and we can acquire the shares we desire which is not true for all trades in real-time.

(b) These indicators may behave differently based on the stock market sector.

(c) If we analyze equities from other nations, the behavior of the models may vary. This constraint is attributable to the sentiments associated with investors.

(d) In the absence of significant stock market volatility, these indicators may not be able to anticipate any trends. This circumstance occurs when all potential investors are awaiting the company's performance before investing.

(e) The equities we have analyzed are based on a certain period of the dataset. When fresh data are added to a model, its precision may change.

17 Ethics

This project provides all materials for research purposes only, with no obligations or particular advice for action. It is not investment advice and cannot be substituted for it. Before engaging in certain transactions and investments, it is advised to consult with a personal financial counselor. One should only engage in such transactions if they have a comprehensive awareness of the nature of the contracts (and contractual relationships) they are engaging in, as well as their risk potential.

Many people are not good candidates for trading futures, options, forex, CFDs, stocks, cryptocurrencies, and other similar financial products. You should think carefully about whether trading is

right for you based on your experience, goals, financial situation, and anything else that is relevant. Historical performance is not indicative of future outcomes. In the content that can be seen, there is no request to trade in any financial instruments or securities. Trading carries with it a potentially significant risk of loss. So, you should look at your finances and, if necessary, talk to a professional to find out if your personal and financial situation allows you to trade and if you are willing to take the high risk of a loss. If you, a broker, or a commercial advisor sets contingent orders, like a "sto p loss" or "stop-limit" order, these orders may not limit your losses to the amount you expected because market conditions may make it impossible to do so.

In addition, trading involves the use of leverage, which may work for or against you. Using these effects of leverage can lead to either huge trading losses or huge trading gains. The trades and developments shown in this project are based only on hypothetical and simulated transactions, minimizing their visual impairment. These results do not represent actual transactions, as would be the case with a real checking account. The results may be too high or too low depending on market conditions, such as a lack of liquidity since the transactions shown haven't happened yet.

Because of this, it is hard to tell if something will happen in the same or a similar way in the future. This project is not meant to provide investment advice. It is not meant to substitute for expert financial counsel. Trading has the potential to be addicting. Please seek professional assistance if you're in trouble. Accept that you have to get legal advice about your property and know everything there is to know about the risks and benefits of trading. Before making any investment decisions, please consult your financial advisor.

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