

# S&P 500 TRADING

## STRATEGIES

**Advisor**

Pr. Emile Servan-Schreiber

**Authors:**

BENNOURI Chaymae

OUKHOUYA Kawtar

EZIRIM Arinze

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## ABSTRACT

*This study aims to analyze existing trading strategies and develop new strategies for the S&P 500 Index. The S&P 500 is one of the most widely followed stock market indices and serves as a benchmark for the overall performance of the US stock market. This study examines various technical and fundamental analysis techniques, as well as quantitative and algorithmic trading strategies, to determine their effectiveness in generating returns from trading the S&P 500. The study also evaluates the accuracy and Brier score of each strategy, the accuracy of the strategy developed by the crowd forecast outperformed the existing strategies which relied on using the relative strength index and moving average convergence divergence. The results of this study provide valuable insights for investors and traders looking to develop and implement trading strategies for the S&P 500.*

## CHAPTER 1

### 1.0 INTRODUCTION

Collective intelligence is the ability of a group to perform numerous tasks which is a function of the group and not the individuals that make up the group Wolley et al.(2010). It also refers to the idea that groups of people are able to accomplish tasks and make decisions that are more effective and intelligent than individuals working alone. This phenomenon is often observed in groups that are able to work together effectively and efficiently, leveraging the knowledge, skills, and perspectives of all members.

There are different ways in which collective intelligence can manifest itself. For example, in a group decision-making setting, the wisdom of the crowd can be leveraged by soliciting opinions and suggestions from all group members and then collectively analyzing and synthesizing the information.

Crowd forecasting is a technique that leverages the collective intelligence of a group of people to make predictions or forecasts about future events Bassamboo et al. (2015). The idea behind crowd forecasting is that a group of people, rather than a single individual, can make more accurate predictions because the group's collective knowledge and diverse perspectives can help to reduce the uncertainty associated with forecasting.

Crowd forecasting has been applied in a wide range of domains including stock market predictions, weather forecasting, political elections, sports predictions and many more Ray, R. (2006). It is important to note that crowd forecasting can have some biases and drawbacks, the accuracy of the prediction can be affected by the size and diversity of the crowd, the quality of the question and the incentives for participants.

The S&P 500, or Standard & Poor's 500, is a stock market index that measures the performance of 500 large-cap stocks in the U.S. stock market. The index is widely considered to be a leading indicator of overall stock market performance and is often used as a benchmark for the performance of mutual funds and other investments.

## 1.1 CONVENTIONAL WAYS OF TRADING S&P 500

There are several strategies that traders and investors use when trading the S&P 500 index, some of the most common are:

1. Trend following: This involves identifying the overall direction of the market and buying or selling stocks that are in a long-term uptrend or downtrend. This strategy can be implemented using moving averages, which can help identify trend direction and market momentum.
2. Value Investing: This involves identifying stocks that are undervalued by the market and purchasing them in the hope that the market will eventually recognize their true value. This is often done by analyzing financial ratios such as the price-to-earnings ratio, the price-to-book ratio, and the dividend yield.
3. Momentum Investing: This involves buying stocks that have recently performed well, and selling stocks that have recently performed poorly. This strategy can be implemented using various technical indicators such as the relative strength index (RSI) and the moving average convergence divergence (MACD).
4. Risk-Adjusted Return: This strategy involves maximizing return while minimizing risk by diversifying the portfolio to reduce the impact of individual stock performance. This is often done by using index funds, which are diversified portfolios that track the performance of a specific stock market index.
5. Options Trading: This strategy is more advanced; it involves buying or selling options contracts that give the holder the right but not the obligation to buy or sell a specific stock at a specific price. It can be used as a hedging mechanism or to speculate on the direction of the market or specific stocks.
6. Swing Trading: This strategy is used for short term trading; it involves buying and selling stocks based on short-term price fluctuations. Traders look for stocks that are trending higher or lower, and will hold the position for several days in order to capture gains.

## 1.2 USING CROWD FORECAST TO TRADE THE S&P 500

Crowd forecasting can be applied in the stock market in a few ways:

1. Prediction Markets: A prediction market harnesses the wisdom of crowds to forecast the future Servan-Schreiber, E. (2018). Participants can buy and sell shares in the outcome of a specific stock's price or performance. The prices of these shares reflect the collective wisdom of the market participants and can be used to make predictions about the stock's future performance.
2. Crowdsourcing: A large number of people are asked to make predictions about a specific stock's future price or performance, and then the answers are analyzed to see if any patterns emerge. The crowd's predictions can then be compared to those of experts or conventional forecasts to see how well the crowd does.
3. Social Media Analysis: With the increasing amount of information available on social media platforms, a lot of stock market predictions are being made based on the collective sentiment of the crowd on social media platforms. Analyzing the sentiment of tweets, posts and comments, can give a lot of insights on how people feel about a specific stock, which can be used as a prediction of its future performance.

## CHAPTER 2

### 2.0 STRATEGIES

#### 2.1.0 EXISTING STRATEGIES

##### 2.1.1 RELATIVE STRENGTH INDEX

The Relative Strength Index (RSI) is a momentum indicator used in technical analysis to measure the strength of a stock or other asset's price action Luis, R et al. (2018). The RSI is calculated using the following formula:

$$RSI = 100 - \left( \frac{100}{1 + RS} \right)$$

Where:

$$RS = \text{Average gain of up period} / \text{Average loss of down periods}$$

The RSI ranges from 0 to 100, with high values indicating that the asset's price is gaining strength (or becoming overbought) and low values indicating that the asset's price is losing strength (or becoming oversold).

A commonly used threshold for determining whether an asset is overbought or oversold is a value of 70 and 30 respectively.

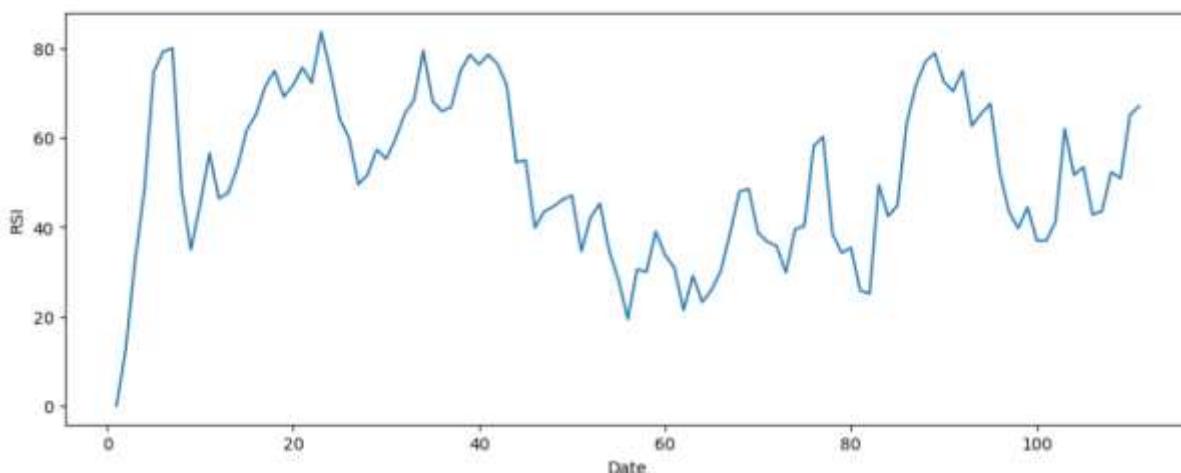


Figure 1: Chart of RSI

The RSI is typically plotted on a chart along with the asset's price action, and when it moves above the 70 level and then falls below it, that is considered as a selling opportunity. Similarly, if RSI falls below 30 level and then rises above it, it is considered as a buying opportunity

## 2.1.2 MOVING AVERAGE

The Moving Average (MA) is a technical indicator used in stock market analysis to smooth out fluctuations in a stock's price by averaging its price over a set period of time Luis, R et al. (2018).

There are several types of moving averages:

- Simple Moving Average (SMA)
- Exponential Moving Average (EMA).

The formula for a simple moving average is:

$$SMA = \frac{\sum i}{N}$$

Where:

i = Closing prices over a specified number of time periods

N = number of time periods

The exponential moving average is a variation of a simple moving average, but it gives more weight to the most recent closing prices.

The formula for an exponential moving average is:

$$EMA = \{Close - EMA \text{ (previous day)}\} \times (2 / n + 1) + EMA \text{ (previous day)}$$

Where:

Close = most recent closing price

EMA (previous day) = the previous day's exponential moving average

n = number of time periods in the moving average

An exponential moving average is considered to be less smooth than a simple moving average, but it reacts more quickly to changes in the stock's price.

Both types of moving averages are commonly used in technical analysis to identify trends, identify support and resistance levels, and generate buy and sell signals. For example, if a stock's price is above its 200-day moving average, it is considered to be in a long-term uptrend, whereas if it is below its 200-day moving average it is considered to be in a long-term downtrend.

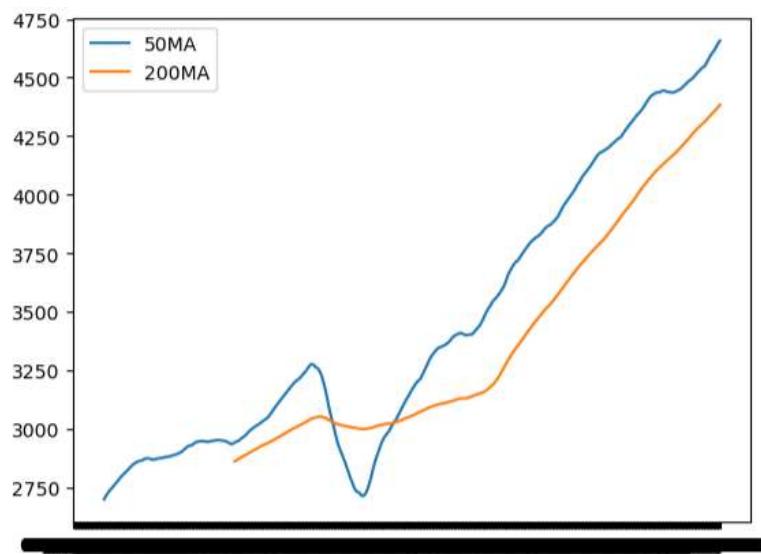


Figure 2: Chart Moving Average

### 2.1.3 MOVING AVERAGE CONVERGENCE DIVERGENCE

The Moving Average Convergence Divergence (MACD) indicator is a technical analysis tool that uses moving averages to identify changes in the strength, direction, momentum, and duration of a stock's price trend Luis, R et al. (2018).

The MACD is calculated using the following formula:

$$\begin{aligned} MACD &= 12\text{day EMA} - 26\text{day EMA} \\ \text{Signal Line} &= 9\text{day EMA of the MCAD} \end{aligned}$$

Where:

EMA = Exponential Moving Average

MACD is commonly used to generate buy and sell signals. When the MACD line crosses above the signal line, it is considered a bullish signal and can indicate a potential buy opportunity. Similarly, when the MACD line crosses below the signal line, it is considered a bearish signal and can indicate a potential sell opportunity. It can also be used to identify trend continuation and trend reversal patterns.

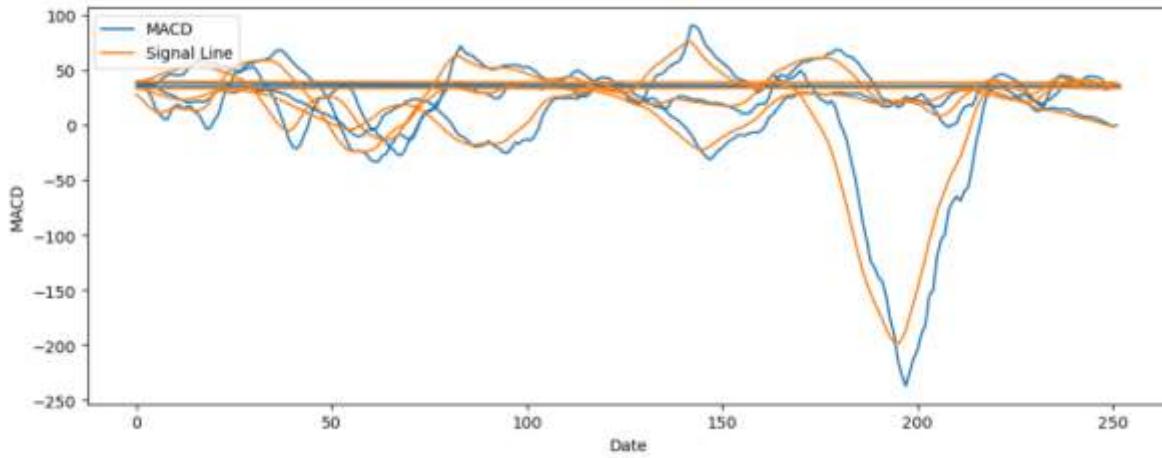


Figure 3: Chart MACD

## 2.2.0 CROWD FORECAST STRATEGY

### 2.2.1 AGGREGATION BY SHARE PRICE

The crowd forecast for S&P 500 was aggregated by share price and the mean of the outcome were compared. The strategy was to compare the mean of up and down for each day and then decide if to go long or short.

$$\bar{x} = \frac{1}{N} \sum (\text{Share price} \begin{cases} Up \\ Down \end{cases}) ; \begin{cases} \text{Down} < \text{Up} \Rightarrow \text{Sell} \\ \text{Down} > \text{Up} \Rightarrow \text{Buy} \end{cases}$$

Where

N: Number of observations in a particular day

### 2.2.2 AGGREGATION BY TRADE QUANTITY

Using the crowd forecast, trade quantity was aggregated using sum for the outcome of up and down, then comparison was made to decide the trading signal for each day.

$$\bar{x} = \sum(Trade\ Qt \begin{cases} Up \\ Down \end{cases}) ; \begin{cases} Down < Up \gg Sell \\ Down > Up \gg Buy \end{cases}$$

## 2.3.0 AGGREGATION MODELS

### 2.3.1 AGGREGATION BY MEAN

Movement of trades for each day were measured, difference between opening, closing, minimum and maximum prices were computed, after a simple average was calculated for each trading day followed by an aggregated mean for a specified number of trading days to ascertain the addition parameter that can be used to signal if to buy or sell stock on any trading day.

$$Target\ price = Opening\ price + \alpha$$

$$\alpha = \frac{1}{n} \sum (Price\ diff)$$

Where:

$$Price\ diff = (diff\_high + diff\_close + diff\_low) / 3$$

$$diff\_high = Highest\ price - Opening\ price$$

$$diff\_low = Opening\ price - Lowest\ price$$

$$diff\_close = Close - Opening\ price$$

### 2.3.2 AGGREGATION by MEDIAN

Movement of trades for each day were measured, differences between opening, closing, minimum and maximum prices were computed, after a simple average was calculated for each trading day followed by determining the median for the price difference for a specified number of trading days to ascertain the addition parameter that can be used to signal if to buy or sell stock on any trading day.

$$\text{Target price} = \text{Opening price} + \beta$$

$$\beta = \text{Median(Price diff)}$$

Where :

$$\text{Price diff} = (\text{diff high} + \text{diff close} + \text{diff low}) / 3$$

$$\text{diff\_high} = \text{Highest price} - \text{Opening price}$$

$$\text{diff\_low} = \text{Opening} - \text{Lowest price}$$

$$\text{diff\_close} = \text{Close price} - \text{Opening price}$$

## CHAPTER 3

### 3.0 ANALYSIS OF RESULT

#### 3.1.0 EXISTING STRATEGIES

##### 3.1.1 RSI AND MACD

This strategy gave an accuracy of 48% when the signal generated were compared with what actually happened in the S&P 500 market for 249 trading days in 2022, this also had a brier score of 0.54.

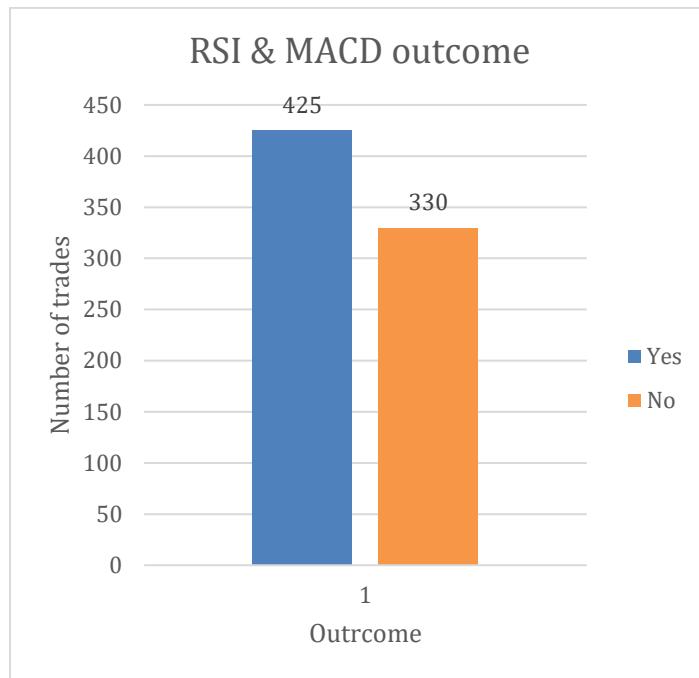
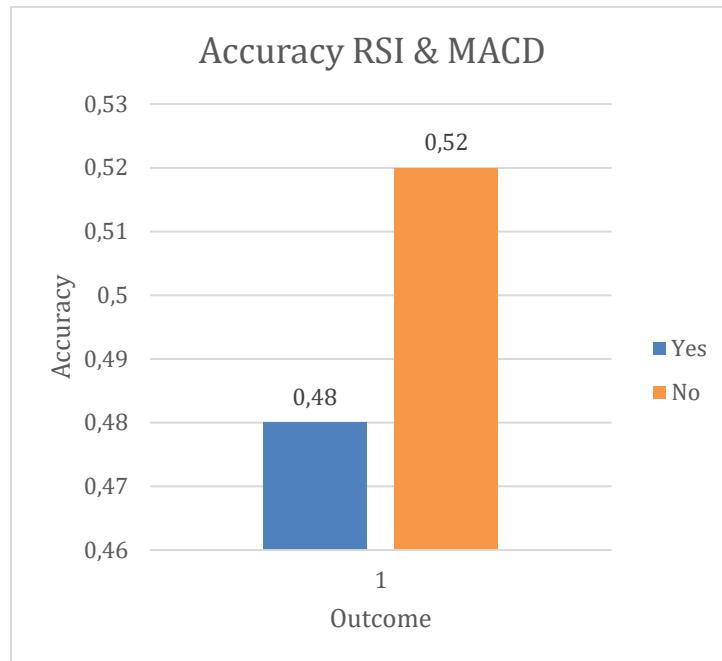


Figure 4: RSI & MCD Outcome

Accuracy:



*Figure 5: RSI & MACD Accuracy*

**Brier Score** = 0.54

### 3.1.2 MOVING AVERAGE

This strategy gave an accuracy of 46% when the signal generated were compared with what actually happened in the S&P 500 market for 252 trading days in 2022, this also had a brier score of 0.58.

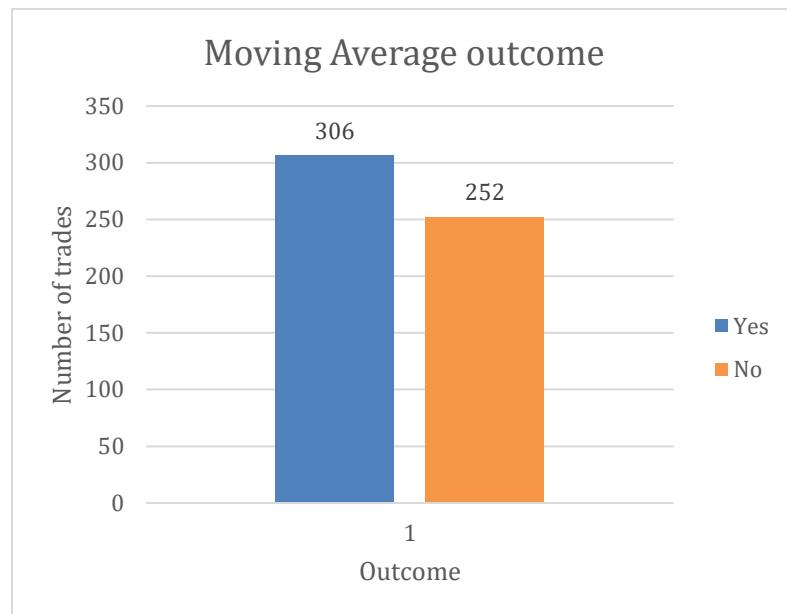


Figure 6: Moving Average Outcome

Accuracy:

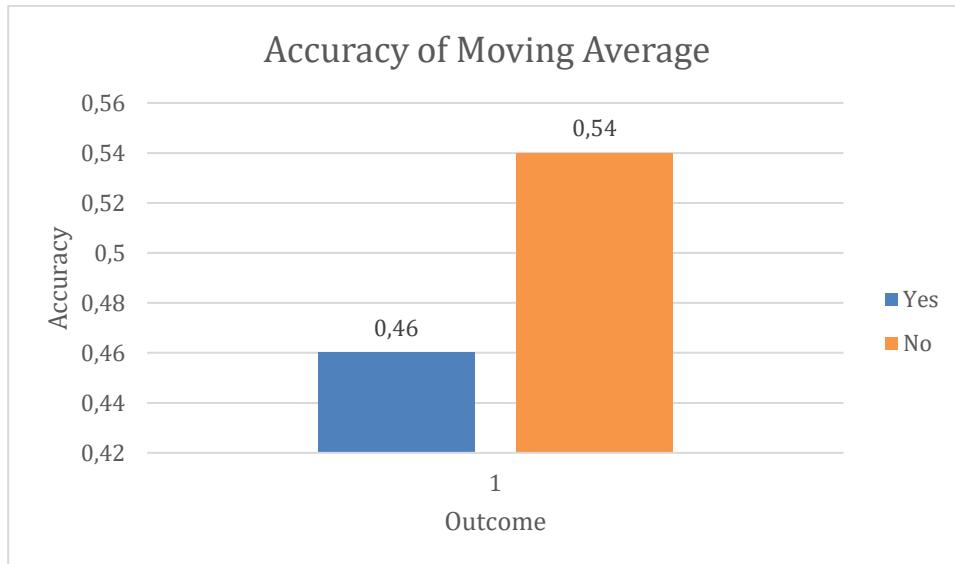


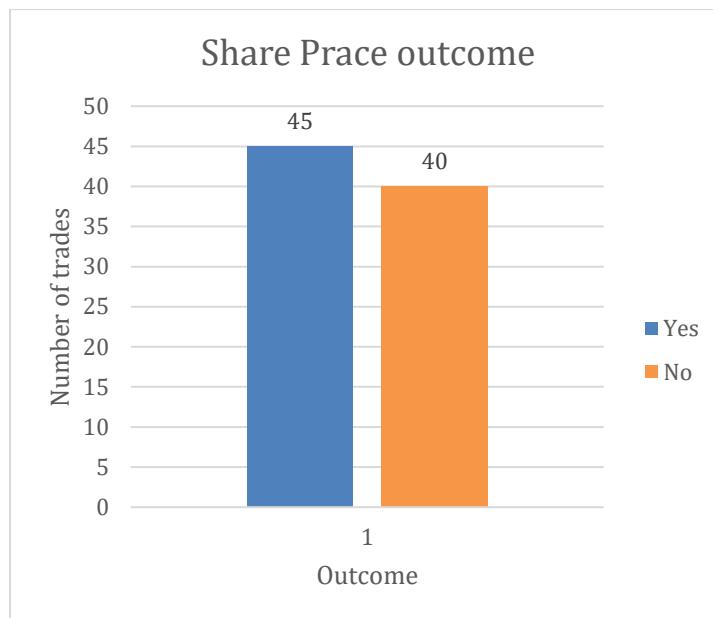
Figure 7: Moving Average accuracy

**Brier Score = 0.58**

### 3.2.0 CROWD FORECAST STRATEGY

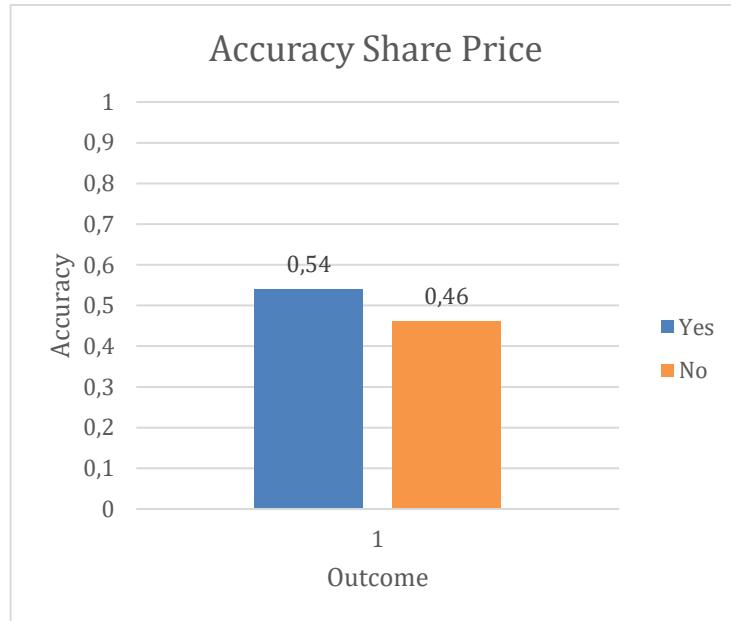
#### 3.2.1 SHARE PRICE

This strategy gave an accuracy of 54% when the signal generated by the crowd forecast were compared with what actually happened in the S&P 500 market for 85 trading days in 2022, this also had a brier score of 0.42



*Figure 8: Chare price Outcome*

Accuracy



*Figure 9: Accuracy Share Price*

**Brier score = 0.42**

### 3.2.1 TRADE QUANTITY

This strategy gave an accuracy of 63% when the signal generated were compared with what actually happened in the S&P 500 market for 61 trading days in 2022, this also had a brier score of 0.27

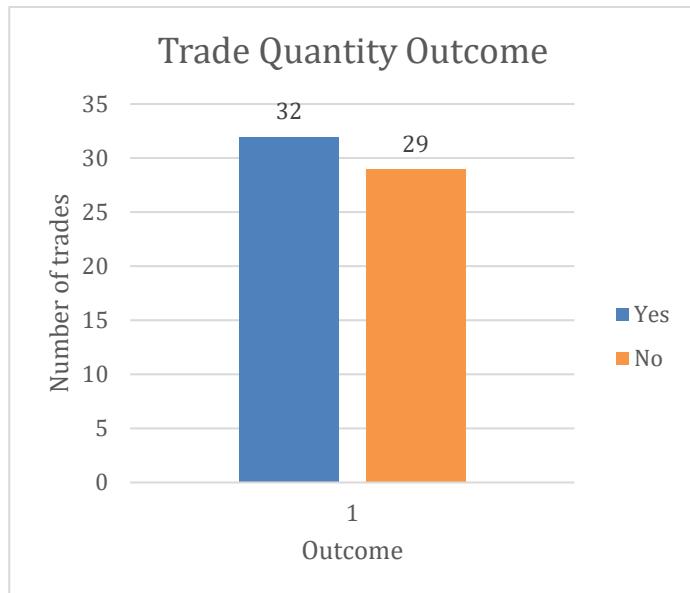


Figure 10: Trade Quantity Outcome

### Accuracy

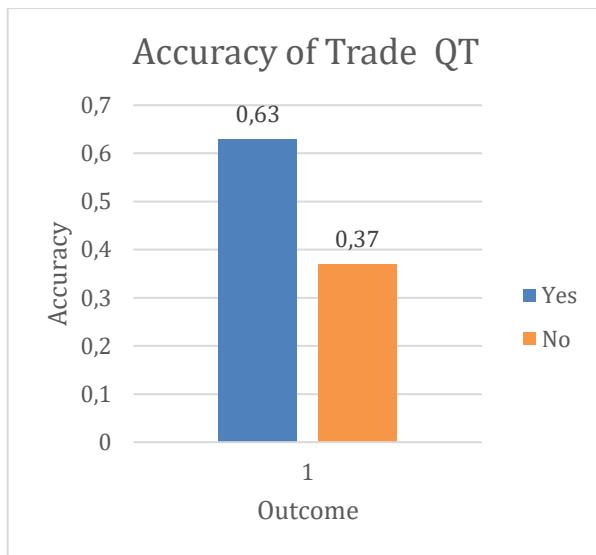


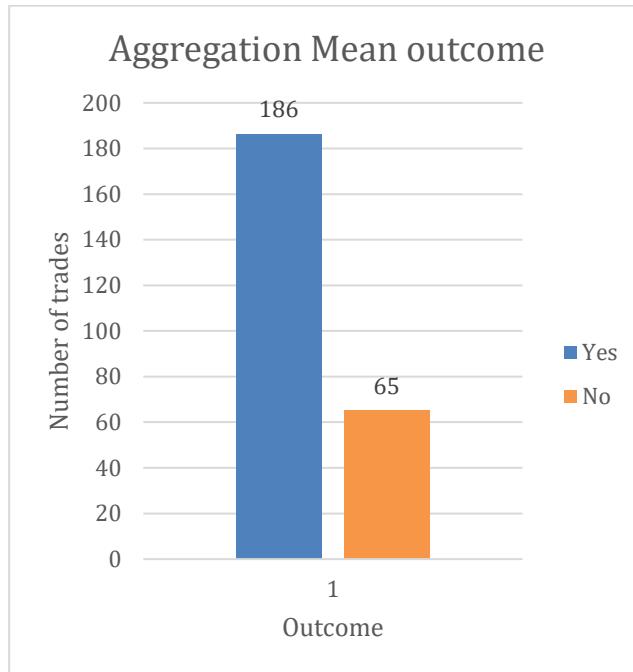
Figure 11: Trade Quantity Accuracy

**Brier Score = 0.27**

### 3.3.0 AGGREGATION MODELS

### 3.3.1 AGGREGATION BY MEAN

This strategy gave an accuracy of 49% in the train data and 75% in the validation test when the signal generated were compared with what actually happened in the S&P 500 market for 249 trading days in 2022, this also had a brier score of 0.13



*Figure 12: Aggregation Mean Outcome*

Accuracy

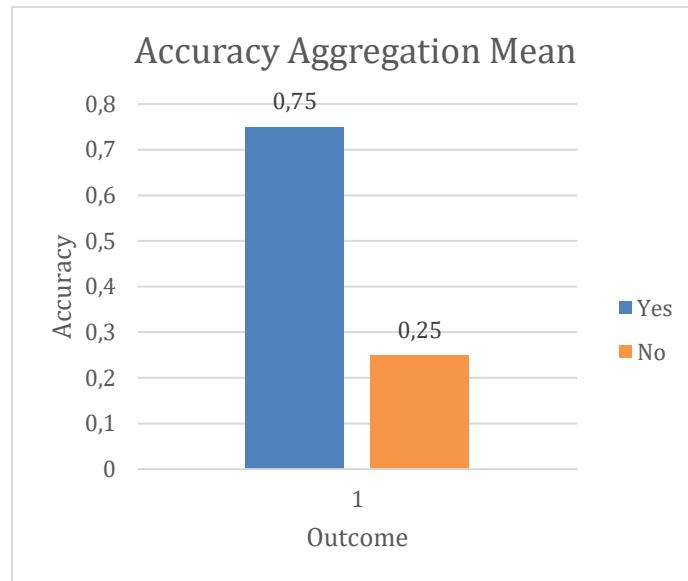


Figure 13: Aggregation Mean Accuracy

**Briere Score = 0.13**

### 3.3.2 AGGREGATION BY MEDIAN

This strategy gave an accuracy of 63% in the train data and 81% in the validation test when the signal generated were compared with what actually happened in the S&P 500 market for 249 trading days in 2022, this also had a brier score of 0.07

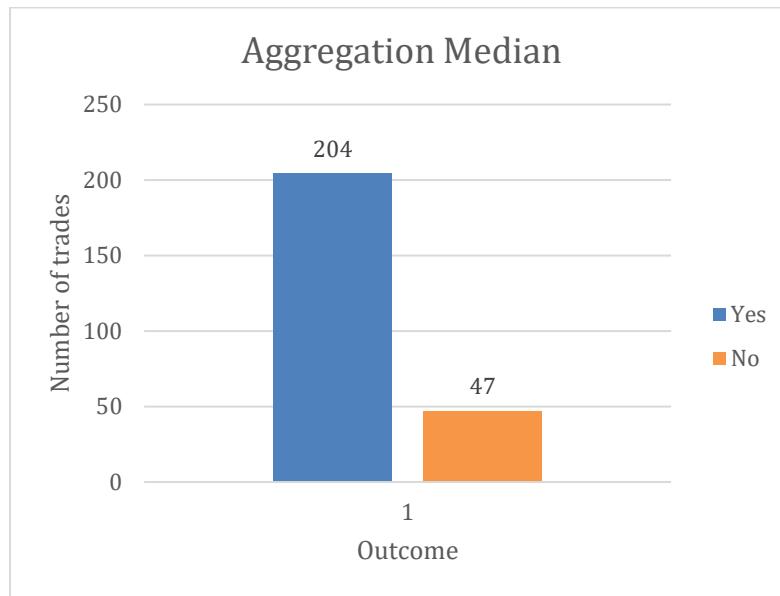
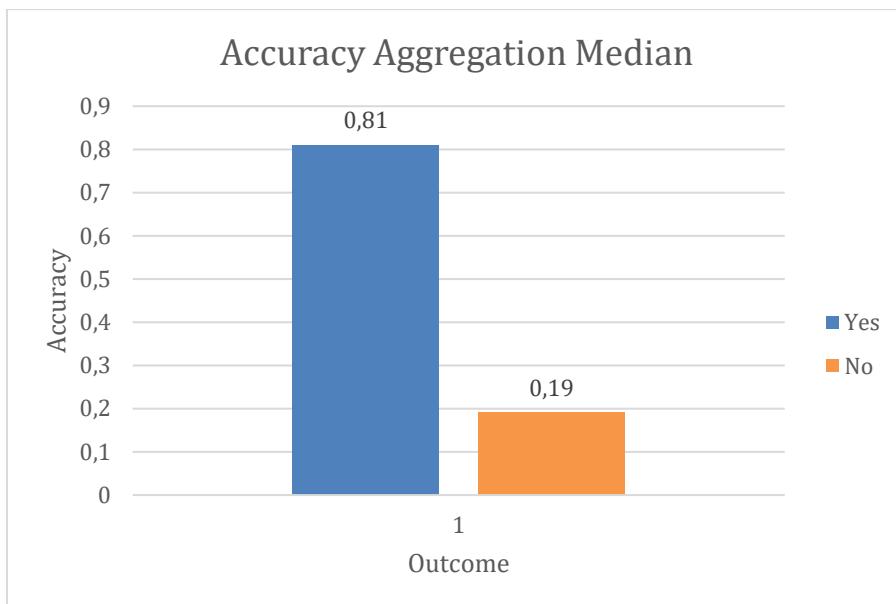


Figure 14: Aggregation Median Outcome

Accuracy



*Figure 15: Aggregation Median Accuracy*

Briere Score = 0.07

### 3.4.0 COMPARISON OF STRATEGIES

#### 3.4.1 ACCURACY

The accuracy of the aggregated median, mean and trade quantity were the most reliable as they had above 60% accuracy when compared to other strategies, this was also affirmed when the brier scores were computed and compared for all 6 strategies with the aggregated models' strategies and that of crowd forecast were less than 0.5 while the existing strategies were all above 0.5

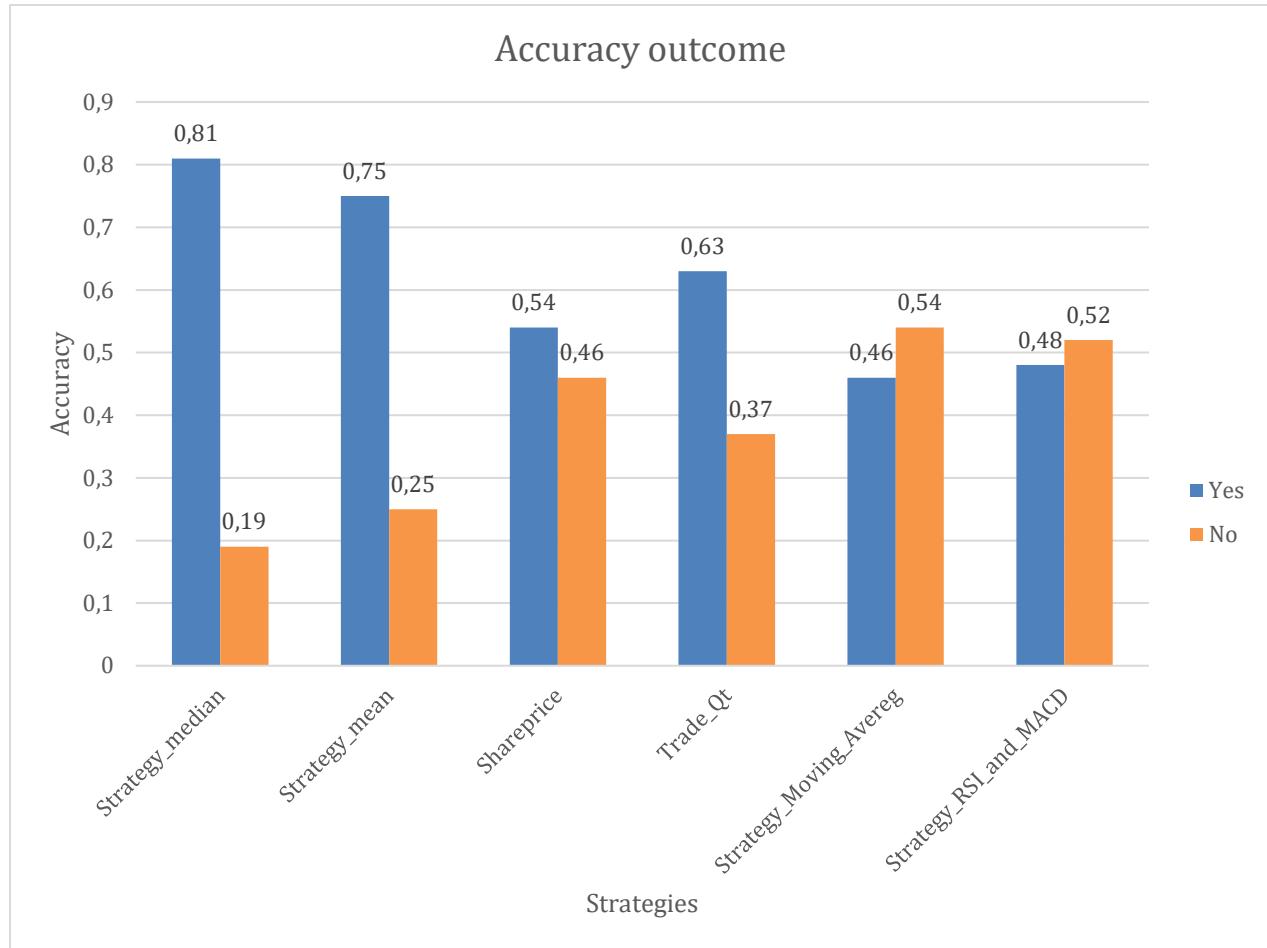


Figure 16: histograms of all the strategies

## Brier score

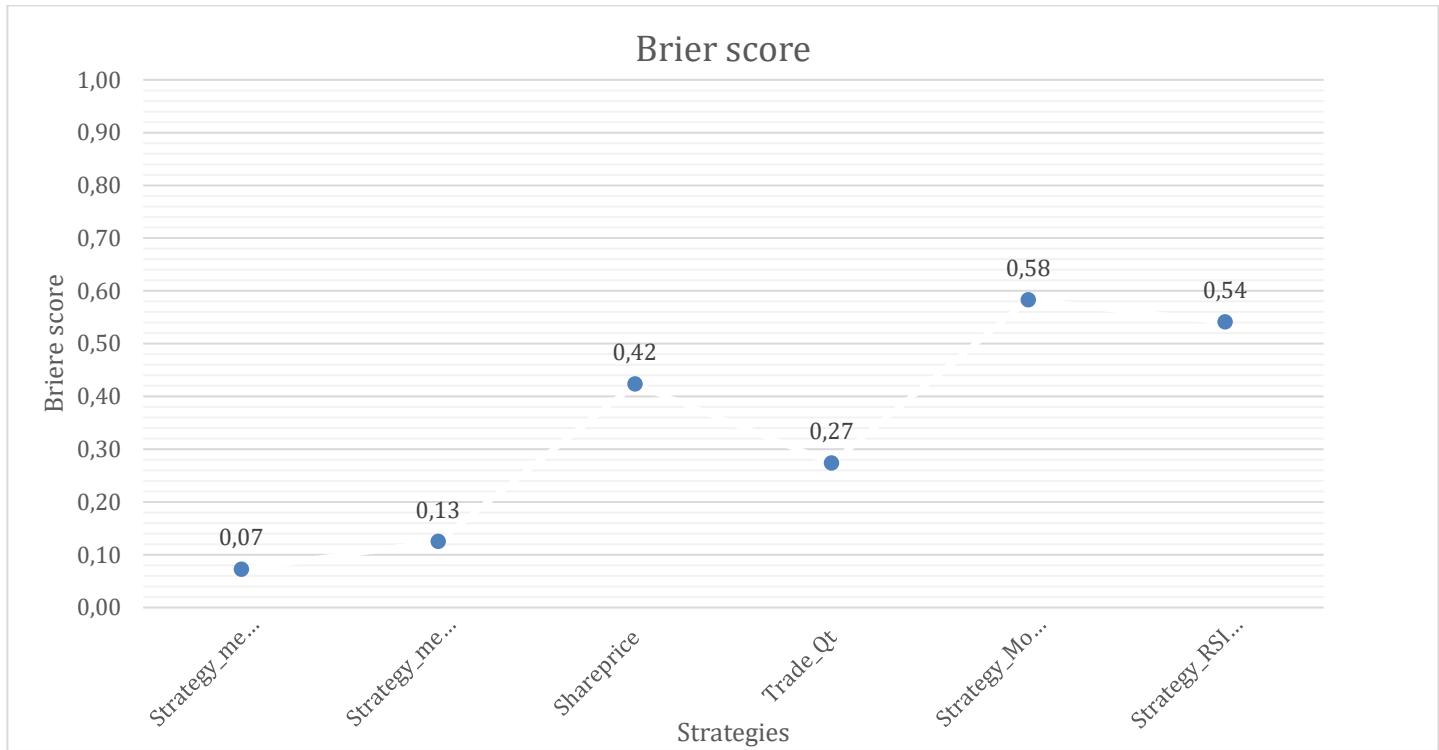


Figure 17: Brier Score of all strategies

## Table for comparison

Metric	RSI & MACD	Moving Average	Share Price	Trade Quantity	Aggregation Mean	Aggregation Median
Accuracy	48%	46%	54%	63%	75%	81%
Brier Score	<b>0,54</b>	<b>0,58</b>	<b>0,42</b>	<b>0,27</b>	<b>0,13</b>	<b>0,07</b>

## 3.5.0 INVESTMENT PLAN

- Risk management uses 1% for every 100\$ to determine the lot size for any particular trade (e.g.: for an investment with 1000\$ use a lot size of 0.1).
- Determine the signal if to buy or to sell, compare the opening price with the current price if the current price is higher than the (opening price + 4) then buy with a target price of (opening price + 13).

- Profit = lot size \* investment (e.g., if lot size is equal to 0.1 and investment in equal to 1000 \$ then the profit is equal to (0.1\*1000) this is for low risk taking).
- To increase the profit made the lot size can be increased but this is not advisable

## CHAPTER 4

### 4.0 FUTURE RESEARCH AND PERSPECTIVES

The crowd forecast has once more shown that aggregated human intelligence with diversity is more reliable to direct traders on what direction to take during a trade as it is more robust with real time data and disruption of patterns unlike machine learning algorithms that rely on past historic data to make decisions.

We can modify the question on the S&P 500 to reflect the forecast of traders on a daily trading day, get more forecasters to give their forecast and then test to see if the numbers of forecasters on every trading has any significant effect on the outcome based on the assumption of that the larger the group the smarter, they are.

Here are three more examples of questions we could ask a group of forecasters to help determine whether to buy or sell the S&P 500 on a specific day of trading:

1. What is the expected range for the S&P 500 price at the end of the trading day?
2. What is the likelihood of the S&P 500 price experiencing a significant change (up or down) during the trading day?
3. Will the S&P 500 go long today?

Analysis on social media content regarding stock market from tweets, blogs, Facebook comments etc. can also be analyzed using sentiment analysis and further aggregated to see what direction a stock will follow, which can serve a collective projection for traders and with other collective intelligence tool like the prediction market can be used to affirm either to buy or sell the stock.

### 4.1 CONCLUSION

The collective intelligence of a group is more reliable in making decisions regarding trading stocks, though this is very effective when the group is large and diverse, as it has proven to be more profitable than existing strategies that rely on historical data. It's important to note that improving the accuracy of the forecast is an ongoing process, it requires continuous evaluation and adjustment, and it's not something that can be achieved easily or quickly but with continuous practice.

## REFERENCES:

- Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science*, 330(6004), 686–688. <https://doi.org/10.1126/science.1193147>
- Bassamboo, A., Cui, R., & Moreno, A. (2015). The wisdom of crowds in operations: Forecasting using prediction markets. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2679663>
- Ray, R. (2006). Prediction markets and the financial "Wisdom of crowds". *Journal of Behavioral Finance*, 7(1), 2–4. [https://doi.org/10.1207/s15427579jpfm0701\\_1](https://doi.org/10.1207/s15427579jpfm0701_1)
- Luis, R, Miguel, J & Erick, L (2018). Trading Strategy on the Future Mini S & P 500. International Journal of Applied Engineering Research Volume 13(13),11018-11024;
- Servan-Schreiber, E. (2018). *Supercollectif: La nouvelle puissance de nos intelligences*. Fayard.