Predicting Stock Movements with Animated Visualization

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ABSTRACT

Stocks have become a globally popular investment instrument in the world. Both teenagers and adults are becoming more interested in technical understanding of stocks investment. In order to empower investors with an obvious buy and stock signal, this study presents signal visualization to trade stocks based on Moving Average Convergence Divergence (MACD), Relative Strength Index (RSI) indicator, with dynamic support and resistance levels to generate reliable buy and sell signals according to the stock price history.

MACD is used to identify trend direction and momentum through moving average crossovers, while RSI provides insight about overbought and oversold conditions, to add more accurate confirmation to ensure that signals occur in favorable market conditions. Dynamic support and resistance levels further enhance signal reliability by identifying critical price thresholds where market reversals or breakouts are likely to occur.

Robust regression in the system is also used to refine the trend for calculating a robust trendline. This can minimize the outlier's impact on slope estimation. This method is compared with standard regression techniques to better adapt to noisy stock price data. Furthermore, the robust trendline can measure trend strength that can contribute to the dynamic adjustment of thresholds for MACD and RSI signals based on market volatility.

Additionally, this program incorporates an accuracy tracking mechanism, which evaluates the success of buy and sell signals by comparing predicted outcomes with actual market performance. The feedback loop drives an adaptive learning process, allowing the system to dynamically adjust key parameters, such as RSI thresholds and MACD sensitivity. These 2 things are used to improve predictive performance over time. By combining price-action analysis, momentum indicators, regression-based trend detection, and adaptive learning, this project delivers a comprehensive and evolving tool for automated stock trading analysis.

INTRODUCTION

Background and Motivation :

"The growing accessibility of stock markets and online trading platforms has led to increased participation from individual investors. However, managing investments effectively requires advanced tools to navigate market complexities."

Predicting the stock market is one of the most challenging yet important in financial analysis. The skills to accurately forecast the market movements may provide a big advantage for traders and investors to optimize returns. However, stock markets are unpredictable and influenced by many factors, such as economic changes, investor behavior, and unexpected shocks, all of these contribute to uncertainty in prediction models (Lopez de Prado, 2018)

Technical analysis has been a popular approach for interpreting market behavior and identifying trading opportunities. Tools such as Moving Average Convergence Divergence (MACD) and Relative Strength Index (RSI) are often used to predict the market momentum and trend. MACD identifies trends by comparing short and long moving averages ; RSI measures the speed and magnitude of price changes which helps traders to avoid extreme market conditions (Chong T. T. L, 2008). In addition to these indicators, support and resistance levels play a critical role in technical analysis, where these levels mark the key price thresholds where a stock is likely to reverse or continue its trend that may help as decision points for buy and sell.

These projects seek to provide visualization and insight by integrating dynamic thresholds and also adaptive learning mechanisms. Dynamic thresholds allow the system to evaluate the accuracy of buy and sell signals and refine the parameters for better performance over time. Additionally, this project also uses robust regression techniques to minimize the impact of outlier prices to enhance trend detection.

Problem :

There are several limitation in existing stock visualisation and tools;

1. Existing tools often don't show the price movements and signals in an animated format. Static charts may make it hard for the users to see how indicators and support/resistance levels evolve over time and how they relate to the market prices.
2. Many existing tools use static threshold rather than adaptive learning

Improvement Proposed :

To overcome the existed problems, this study proposes a stock and signal visualization on animation mode , Innovations Included :

- Clear, Animated visualization that shows stock price movements, indicators and also signals.
- Adaptive learning by the program to refine the signal based on the market condition
- Real time accuracy evaluation to improve reliability and also decision making

Goal and Objectives :

1. Evaluate the effectiveness of integrating dynamic thresholds and adaptive learning into technical analysis tools for stock price prediction.
2. Demonstrate how combining MACD, RSI, and support/resistance levels with dynamic adjustments can improve the reliability of buy and sell signals.
3. Provides a comprehensive framework for analyzing stock prices and optimizing trading strategies in volatile markets.

Tentative Result :

The proposed tool is expected to:

1. Clearly animated visualization of stock trends and signals
2. Proposed an accurate buy and sell signals through adaptive learning
3. Enhanced trend detection with robust regression and support/resistance

Benefit :

1. Enhanced decision making for the traders based on the adaptive learning signals.
2. Improved understanding of market trends through animated visualization

Related Work

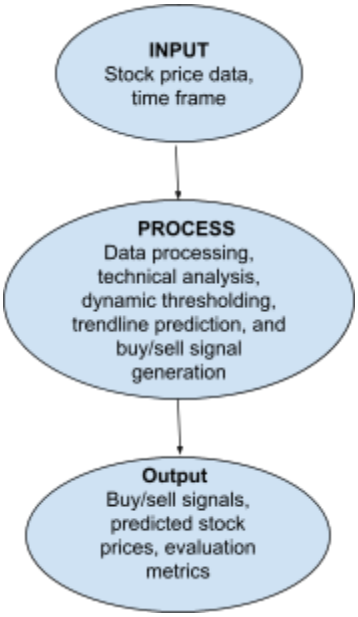
A lot of studies have tried to improve the stock market prediction by using technical analysis and also computational techniques. Traditional tools, such as Moving Average Convergence Divergence (MACD) and the Relative Strength Index (RSI) have been widely used but often seen as limited because they are static and do not adapt to the changing nature of the stock market. Recent work has explored ways to overcome the traditional static nature. Y Chen et al (2021) has proposed dynamic adjustments for RSI thresholds based on the market; This method showed that adjusting threshold for RSI could help to predict stock movements more accurately. Similarly, Velmurugan et al (2021) integrate support and resistance levels into machine learning models that could enhance decision making in price action strategies. However, these studies often fail to adapt dynamically real time market conditions and also provide clear visualizations for users.

Methodology

1. **Framework**

Input: Stock price data and timeframe

Process: Data processing, technical analysis, dynamic thresholding, trendline prediction, and buy/sell signal generation.
Output: Buy/sell signals, predicted stock prices, evaluation metrics like accuracy.



2. **Data Collection**
Data is collected using Yahoo Finance API that collects historical stock data for a specific stock over a defined period (e.g., from January 2024 to November 2024). The data includes daily closing prices, volume.

3. **Design**

This study aims to model stock price prediction using technical analysis indicators and dynamic learning to improve the accuracy of buy/sell signals. The phenomena studied are the predictive relationships between stock prices movements and market indicators such as MACD and RSI, with a focus on the support and resistance levels that become the equilibrium levels in the market. In addition, animation of the support and resistance levels, as well as trendline predictions, will be used to illustrate how these factors influence market behavior.

4. Research Question

- What is the impact of dynamic thresholds on the accuracy of buy/sell signals compared to traditional methods)?
- How do MACD and RSI interact with dynamic support/resistance levels in predicting stock prices accurately?
- Can adaptive learning improve the accuracy of predictions over time as more data is processed?

5. Hypothesis

The study hypothesizes that dynamic adjustments to technical indicators (RSI and MACD) will significantly improve the accuracy of stock price predictions compared to static models. Specifically, it is expected that dynamic models incorporating real-time data adaptation will result in higher prediction accuracy and better decision-making performance.

6. Models

- **Relative Strength Index (RSI)**

  Definition:

  The RSI measures the speed and magnitude of price changes to identify overbought or oversold conditions.

  How it works :

  Dynamic RSI thresholds are introduced, adapting to prediction accuracy over time.

  It calculated using a 14-day rolling window to assess momentum and overbought/oversold conditions.

- **Moving Average Convergence Divergence (MACD)**

  Definition:

  - The MACD tracks the relationship between two EMAs (short-term and long-term) to identify trend changes.

    Formula :

    1. MACD Line : Difference between the 12-day EMA and the 26-day

       MACD = EMA_9 - EMA_{21}

    2. Signal Line : 9 Day EMA of the MACD line
    3. Histogram : Difference between the MACD Line and the signal line

    Histogram = MACD - Signal Line

  Usage:

  - Buy Signal: When the MACD line crosses above the Signal line.
  - Sell Signal: When the MACD line crosses below the Signal line.

  How it works :

  - Derived using 9-day and 21-day exponential moving averages (EMA).
  - The signal line is calculated as the 9-day EMA of the MACD line to indicate buy/sell signals through crossovers.

- Robust Trend Line
  - **Definition**

Robust trend line represents the overall direction of price movement in the current window, minimizing the influence of outliers (e.g., sudden price spikes or drops).

- **Method Used**

1. Fitting Huber Regressor

   Huber Regressor is a robust linear regression model that used to fit the trend line.

   The **Huber Regressor** model is initialized and trained using the fit method:

   Input to fit:

   X : the indices reshaped to a 2D array (x $\in R^{n\,x\,1}$)

   Y : the closing prices (Y $\in R^{n}$)

Output:

- The model learns a linear relationship between x (indices) and y (closing prices), minimizing the impact of outliers.

1. Predict trend line values

   Predictions for the trend line values are generated using the predict method

   The predicted values represent the trend line for the closing prices in the given window. The values are computed as :

$\overline{y} = \beta_0 + \beta_1 \cdot x$

β_0 = intercept of trend line

β_1 = slope of the trend line

X = input indices

- Support and Resistance Levels
  a. Static Levels

     Definition:

     Static support and resistance levels are horizontal lines that mark the lowest and highest price points within a selected window of historical data.

     Calculation method :

     - Identify the range of data in the current window.
     - Compute the static support as the minimum value of the Low prices in the window.
     - Compute the static resistance as the maximum value of the High prices in the window.

  b. Dynamic Levels

     Definition: Dynamic support and resistance levels adjust as the price breaks through static levels. A breakout above resistance turns the resistance into a

new support, and a breakdown below support turns the support into a new resistance.

Calculation method :

- Monitor the closing price relative to the static levels.
- Check for a breakout above the static resistance with sufficient confirmation:

  A breakout is confirmed if:

  The closing price exceeds the static resistance by a threshold percentage.

  Recent closing prices (confirmation candles) stay above the resistance.

7. Input Variables

The input variables in our program are the desired indonesian stock with the time frame test.

8. Control Variables

Trading time intervals is set into daily

9. Output

The output of our programs will be the animation of the stock price in a time frame including the support/resistance line, buy & sell signals and also the predictive table result.

10. Performances Indices

The Performance indices used to evaluate the models is the accuracy over a period of time.

11. Parameters

- MACD Threshold (set 0.01)
  Used to filter out weak signals from the MACD indicator.
- Expected return factor (set as 0.5)
  Determines the impact of MACD strength on the predicted price change for a buy or sell signal
- Trend Slope Factor (set as 5)
  Determines how much the slope of the robust trend line contributes to the expected return.

12. Search/ Optimization

Our purpose is to find the best parameters of combined indicators to maximize the accurateness of market prediction.

Implementation and Result

Visualisation :
This Program shows an animated visualization of stock price changes, that will display real-time updates of the price movement. This program also highlights the support/resistance line, signals and the accuracy test. Below the stock price chart, an animated MACD line will be displayed, offering clarity on market momentum and helping users better understand price trends and signal generation.

Insight :

1. The program has successfully identified the turning points in the stock market using MACD and support/resistance levels.
2. It succeeded to integrate the adaptive learning that allows the system to adjust the thresholds based on the market.
3. The accuracy test are able to check the prediction correctly

Weakness :
The system's accuracy is relatively low, indicating that the model may wrongly react to false breakouts or fail to predict trends correctly. In addition, some buy and sell signals are too closely spaced that may lead to conflict/redundant prediction.

Potential Improvements :

1. Incorporate additional indicators such as Bollinger bands or volume-weighted analysis to filter out false signals and more accurate predictions.
2. Refine the dynamic threshold algorithm to better adapt the market and avoid overfitting.
3. Evaluate the use of machine learning models to enhance prediction accuracy.

Sources

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