Basic Stock Bot Back Testing Simple Algorithms Report

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# **Abstract:**

This report presents the results of back testing several simple algorithms for stock trading using historical stock data. The algorithms utilize techniques such as Relative Strength Index (RSI), Moving Average (MA), and heuristics-based strategies to determine buy and sell points. The performance of each algorithm is evaluated across different stocks and time frames, and comparisons are made to assess their effectiveness.

# **Introduction:**

In this assignment, the task at hand involves exploring basic stock trading algorithms through practical application and analysis. The objective is to amalgamate skills acquired in this course to load historical stock data, model trading strategies, and conduct comprehensive back testing of these strategies.

The endeavor begins with the collection of stock data from Yahoo Finance and subsequent visualization in Excel to gain insights into stock performance. Leveraging existing CSV loading code, the data is organized into structured formats suitable for analysis.

Key components of the analysis include the calculation of the Relative Strength Index (RSI) and the creation of a Moving Average (MA) trend line. These metrics serve as foundational elements in evaluating market momentum and determining potential buy and sell points.

Furthermore, a stock bot program is developed to automate trading decisions based on RSI and MA signals. The program initializes with a starting balance and iterates through the loaded stock data, executing buy and sell actions as per predefined trading rules.

Lastly, heuristic-based trading algorithms are explored to guide buy and sell decisions. Three algorithms are devised, including a buy-and-hold strategy, RSI and MA-based strategy, and a custom algorithm. These algorithms are then tested across various stocks and time frames to evaluate their performance and effectiveness.

# **Methodology:**

## **1. Collecting Stock Data:**

- Stock data was obtained from Yahoo Finance, focusing on weekly data for the chosen stock.

- The data was loaded into Array Lists or data structures for further analysis.

### Figure 1

### Figure 2

## **2. Calculate Relative Strength Index (RSI):**

- RSI was calculated using the formula provided, utilizing the average up and down moves over a specified period.

- RSI values were graphed along with the stock data for validation.

Figure 3

## **3. Creating a Moving Average Trend Line (MA):**

- A moving average trend line was generated using a smoothing algorithm on the loaded stock data.

- The MA line was overlaid with the stock data to visualize trends.

Figure 4

## **4. Writing a Stock Bot:**

- A stock trading bot was developed to utilize RSI and MA to determine buy and sell points.

- The bot initialized with a starting balance and implemented a method to evaluate trades at each date based on predefined criteria.

## **5. Trading Algorithms:**

- Three trading algorithms were implemented: **buy and hold, RSI + Moving Average, and a custom heuristic-based strategy.**

- Each algorithm utilized different heuristics to guide buy and sell decisions.

1. **Buy and Hold Algorithm:**
   * **Heuristic:** The buy and hold algorithm follows a simple heuristic of purchasing a predetermined quantity of stock and holding it for an extended period, typically a year or more.
   * **Explanation:** This strategy is based on the heuristic assumption that over the long term, the stock market tends to trend upward, and thus holding onto stocks for extended periods will result in overall gains. It does not involve active buying or selling decisions based on market conditions or technical indicators.
2. **RSI and Moving Average Algorithm:**
   * **Heuristics:**
     + Relative Strength Index (RSI): This algorithm uses RSI as a heuristic indicator to identify overbought (RSI > 70) and oversold (RSI < 30) conditions in the market. It may buy when the RSI is below 30, indicating potential undervaluation, and sell when the RSI is above 70, indicating potential overvaluation.
     + Moving Average (MA): The algorithm uses moving average crossovers (e.g., when the short-term MA crosses above the long-term MA) as heuristic signals to identify potential trend reversals and entry/exit points.
   * **Explanation:** By combining RSI and MA signals, this algorithm aims to capitalize on short to medium-term market trends. RSI helps identify short-term price extremes, while MA provides trend-following signals. Buy and sell decisions are made based on these heuristic indicators.
3. **Custom Algorithm:**

* **Heuristics**: The custom algorithm incorporates the following heuristic indicators:
* **Simple Moving Average (SMA):** Calculates the SMA over a specified period (smaPeriod) to identify trends in stock prices. Buying decisions are made when the stock price falls below the SMA, indicating potential undervaluation.
* **Stop-Loss Mechanism:** Implements a stop-loss mechanism to limit potential losses. If the net worth (current balance plus the value of shares owned) falls below a certain threshold determined by the stop-loss percentage (stopLossPercentage), the algorithm triggers a sell decision to mitigate further losses.
* **Transaction Cost Management:** Accounts for transaction costs associated with buying and selling stocks by deducting a transaction cost percentage (transactionCostPercentage) from the current balance after each trade.
* **Explanation**: The custom algorithm utilizes a combination of these heuristics to guide buy and sell decisions. By analyzing the SMA trend, managing stop-loss thresholds, and considering transaction costs, the algorithm aims to optimize trading performance while minimizing risks.

### **Summary**

1. **Buy and Hold Algorithm:**
   * **Net Worth:** Demonstrated stable growth over time, reflecting a long-term investment approach.
   * **Number of Trades:** Minimal trading activity, typically involving only one initial trade.
   * **Profitability:** Relied on capital appreciation, with profits realized over the long term.
2. **RSI and Moving Average Algorithm:**
   * **Net Worth:** Showed dynamic fluctuations, responsive to RSI and moving average signals.
   * **Number of Trades:** Executed a moderate to high number of trades, reacting to market movements.
   * **Profitability:** Varied based on the accuracy of buy and sell signals generated by RSI and moving averages.
3. **Custom Algorithm:**
   * **Net Worth:** Demonstrated diverse performance outcomes, adapting to heuristic-based rules.
   * **Number of Trades:** Varied based on heuristic indicators used, aiming to optimize trading decisions.
   * **Profitability:** Depended on the interpretation of heuristic indicators, contributing to profitability.

## **6. Testing:**

- The algorithms were tested on multiple stocks and time frames, including daily, weekly, and yearly data.

- Performance metrics such as net worth and trade outcomes were analyzed for each algorithm.

### **Findings**

The performance of algorithms varied across different time frames and stocks, revealing insights into their effectiveness under various market conditions:

1. **Time Frames:**
   * **Daily:** Algorithms exhibited higher frequency trading, responding to short-term price fluctuations. This led to increased transaction costs and potentially higher volatility in net worth.
   * **Weekly:** Algorithms demonstrated more stable performance, benefiting from reduced noise in the data and allowing for better execution of trading strategies over longer intervals.
   * **Yearly:** Performance was characterized by slower changes in net worth, reflecting the long-term nature of investment decisions made by the algorithms.
2. **Stocks:**
   * **High Volatility Stocks:** Algorithms showed greater sensitivity to price movements, resulting in more frequent trades and higher variability in net worth. While potentially offering higher returns, they also posed greater risks.
   * **Stable Stocks:** Performance was characterized by smoother net worth curves and fewer trades, indicating less volatility in stock prices. Algorithms tended to generate more consistent returns but with lower potential for significant gains.

# **Conclusion:**

In conclusion, the back testing of simple stock trading algorithms provided insights into their effectiveness and limitations. The RSI + Moving Average algorithm showed promising results in identifying profitable trades, while the custom heuristic-based approach offered flexibility but required careful parameter tuning. Further research and optimization are recommended to enhance the performance of these algorithms in real-world trading scenarios.

# **References:**

- Yahoo Finance for stock data retrieval.

- Macroption (https://www.macroption.com/rsi-calculation/) for RSI calculation methodology.

# **Appendices:**

All codes (written in Java) and data files (excel and csv) are included in the Basic Stock Bot folder.