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Project 2: Interactive Multi-Stock Visualization Dashboard with Buy/Sell Signals

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Abstract

This project presents an interactive dashboard for visualizing multi-stock market data, allowing users to explore stock price trends, trading volumes, volatility, and candlestick charts across multiple selected stocks and customizable date ranges. A key feature is the integration of various buy/sell signal indicators tailored for beginner investors, designed specifically for each type of chart. The solution leverages R's Shiny framework combined with modern visualization libraries to deliver a responsive and insightful user experience. This report documents the motivation, methods, implementation, results, limitations, and potential future enhancements.

1 Introduction

The goal of this project was to create an interactive dashboard that allows users to explore and analyze stock market data from multiple companies simultaneously, enhanced with beginner-friendly buy/sell signals for each visualization type. This dashboard supports dynamic selections of stocks and date ranges, enabling users to compare price trends, trading volumes, and market volatility across different stocks. The dataset includes daily OHLC (Open, High, Low, Close) prices and volume for five major technology stocks: Apple, Amazon, Google, Microsoft, and Nvidia.

Unlike conventional stock tools that typically show a single stock or static charts, our project facilitates multi-stock analysis with smooth interactivity and actionable signals to assist investment decisions.

2 Justification of Approach

To build this solution, we chose the R Shiny framework due to its strength in creating interactive web applications with reactive inputs and outputs. Shiny's seamless integration with various visualization libraries allows us to combine multiple chart types in one interface and respond instantly to user selections.

The primary visualization package used is **highcharter**, which supports stock charts with built-in zoom and range selectors, and flexible series additions such as candlesticks, line charts, and scatter plots for signals.

The **zoo** package is used for calculating rolling statistics like moving averages and rolling standard deviations, essential for smoothing data and detecting volatility.

3 Data Processing

The dashboard filters and reshapes the stock data reactively based on user inputs, including selected stocks and date range. The original wide-format dataset (with columns like `Open_AAPL`) is reshaped to a long format for easier manipulation and visualization.

Time series transformations using `zoo` include:

- Fixed 30-day moving averages for price trend smoothing.
- Rolling 20-day standard deviation as a measure of volatility.
- Additional derived metrics required for signal detection such as short-term and long-term MAs and smoothed volume.

4 Signal Indicators for Beginner Investors

To provide actionable insights for beginners, we implemented distinct buy/sell signal indicators tailored for each chart type:

4.1 Candlestick Chart Signals: Bullish/Bearish Engulfing Patterns

Engulfing patterns are classic candlestick reversal signals:

- **Bullish Engulfing (Buy)**: A small red candle followed by a larger green candle that completely covers the previous candle's range, signaling potential upward reversal.
- **Bearish Engulfing (Sell)**: A small green candle followed by a larger red candle engulfing it, indicating possible downward reversal.

These signals are marked with green upward and red downward triangles on the chart.

4.2 Volume Trends Signals: Volume Spike with Price Direction

Significant spikes in trading volume often precede notable price moves:

- **Buy Signal**: Volume greater than 1.5 times the 10-day smoothed volume, combined with a price increase compared to previous day.
- **Sell Signal**: Similar volume spike but accompanied by a price decrease.

These are visualized as markers on the volume chart to highlight unusual trading activity.

4.3 Price Trend Signals: Moving Average Crossover

A commonly used technical indicator:

- **Buy Signal**: The 15-day MA crosses above the 50-day MA, indicating potential bullish momentum.
- **Sell Signal**: The 15-day MA crosses below the 50-day MA, signaling possible bearish trend.

Signals are displayed as markers on the price trend line chart.

4.4 Volatility Chart Signals: Volatility Breakout

Volatility breakouts can indicate major market moves:

- **Buy Signal**: Volatility exceeds its 20-day moving average plus one standard deviation, suggesting increasing risk/opportunity.
- **Sell Signal**: Volatility falls below its moving average minus one standard deviation.

Marked with triangles on the volatility chart to indicate significant shifts in price variability.

4.5 RSI Chart Signals: Overbought/Oversold Regions

RSI is a momentum oscillator with standard thresholds:

- **Overbought** (>70): Potential sell signal.
- **Oversold** (<30): Potential buy signal.

These zones are shaded on the RSI chart to guide investors.

5 Data Visualization Techniques

We use **highcharter**'s stock charts for all visualizations, enabling consistent zooming, panning, and range selection. Signal markers are added as scatter series overlayed on line or candlestick charts, providing clear visual cues without clutter.

6 Interactivity and User Experience

Each visualization tab includes a dedicated toggle to show or hide the buy/sell signals, ensuring users can customize the information displayed according to their needs. The zoom slider (range selector) is enabled across all charts, allowing detailed inspection of specific time windows.

7 Discussion of Results

The dashboard empowers users to:

- Compare multiple stocks' price, volume, volatility, and momentum simultaneously.
- Detect actionable signals tailored to each data dimension, enhancing beginner investors' ability to interpret market data.
- Interactively explore historical data through zoom and filter controls.

8 Limitations

- Signals are based on basic technical rules and may generate false positives.
- The dataset is static; real-time data and expanded stock universe would improve relevance.
- UI may become crowded with many stocks selected simultaneously.

9 Future Enhancements

- Integrate real-time data feeds and notifications.
- Add more sophisticated predictive models and signal combinations.
- Improve UI with cross-filtering and drill-down capabilities.
- Allow user customization of signal parameters.

10 User Manual

To use the dashboard:

1. Open the Shiny app locally or via the hosted URL.
2. Select stocks and date ranges from the sidebar.
3. Navigate visualization tabs to view different aspects of stock data.
4. Use the "Show Buy/Sell Signals" checkbox in each tab to toggle signal display on that chart.
5. Use the zoom slider on each chart to focus on desired time periods.

11 Code Reproducibility

The code is modular, well-documented, and relies on publicly available R packages (`shiny`, `shinydashboard`, `highcharter`, `zoo`). Running the provided `app.R` script along with the `stock.csv` dataset reproduces the complete dashboard and its features.

The project repository is hosted on GitHub: `https://github.com/binhdzhihi/Stock-Market-Visualize`