Stock Recommender

Jennifer Xin
Jjx4 – jjx4@scarletmail.rutgers.edu

Table of Contents

Abstract

Stock Recommender is a web-based application designed to advise portfolio decisions for novice investors by analyzing stocks from the major indices like S&P 500, NASDAQ, and DOW. This paper presents a unique scoring system that combines one-year linear regression slopes, price-to-earnings ratios (P/E ratio), and the Relative Strength Index (RSI) to identify promising stocks and potential stocks to sell. The structure of the web service is also addressed and succinctly explained.

1. Introduction

Stock Recommender is a web application designed to recommend the top 10 investment opportunities from the S&P 500, NASDAQ, and DOW indices, as well as identify the top 10 stocks to consider selling. This application utilizes a scoring system that integrates a one-year linear regression slope analysis, price-to-earnings ratio (P/E ratio), and the Relative Strength Index (RSI) to rank stocks based on their potential for growth and risk levels. This approach has the ability to find stocks that are likely to enhance portfolio performance and the ability to warn users about stocks that may underperform.

The value of Stock Recommender lies in its unique scoring system not seen in existing services. Traditional stock advisory services typically rely on basic market trends, financial metrics, and news reports that may not rely on combining data analysis with stock valuation metrics. Novice investors are prone to focusing solely on market summaries or trend graphs and are unable to perform data analysis. My service will help them focus on valuation metrics they may not understand and perform data analysis through linear regression for them.

Stock Recommender's solution in using a scoring system to rank stocks is effective because it combines historical data analysis with valuation metrics to find stocks with good growth potential. One-year linear regression slope analysis is extremely effective in identifying growth trends, while looking at P/E ratios and RSI indices are particularly helping in weighing risk factors with potential. Furthermore, my solution is presented in a completely transparent way by providing all the metrics used to calculate the scores in a user-friendly user interface.

The rest of the paper is structured as follows: Section 2 discusses related work. Section 3 explains the background of the service. Section 4 summarizes the service provided. Section 5 explains the user interface of the service. Section 6 details the implementation of Stock Recommender. Section 7 includes the evaluation of the service. Finally, Section 8 includes the claims of the service.

2. Cross-reference to related work

There are many sources on the internet that provide recommendations like: "Top 10 Best Stocks to Investment In", etc. A lot of these articles published by reputable sites provide a brief background of the stock and logical reasoning as to why to invest in certain stocks. There are also subscription services like Motley Fool's monthly stock picks which provide recommendations and stock analyses. Stock Recommender is completely free and transparent in its recommendation method, providing users with enough information to make their own informed decisions. My service may not factor in a lot of the information that bigger sources are privy to, but it provides all of components that go into its rankings.

3. Background of the service

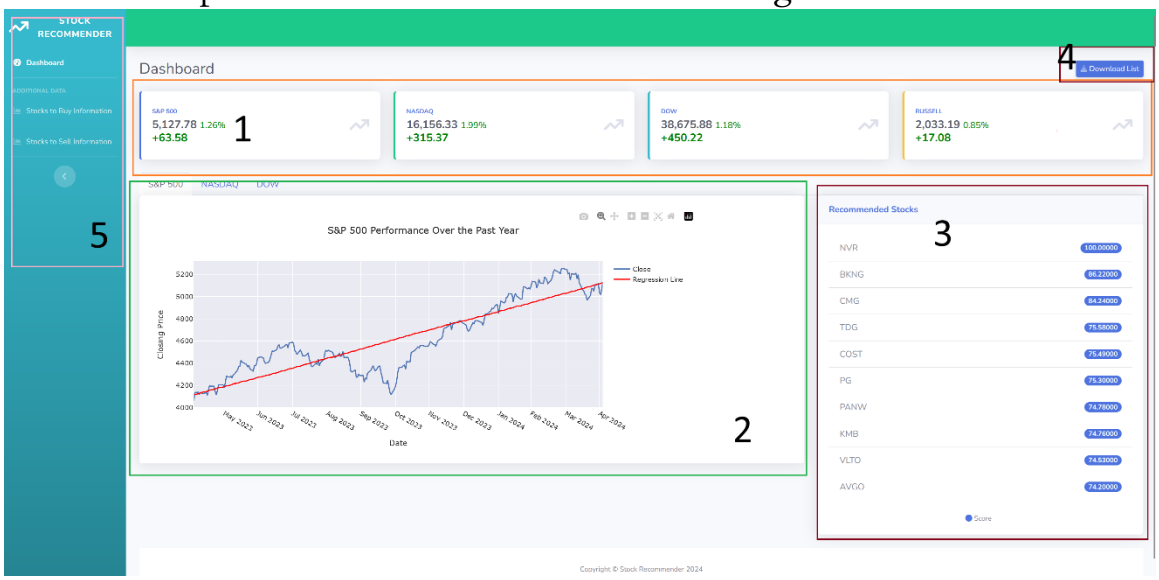
Stock Recommender operates within the field of financial technology, specifically focusing on investment advisory services. This service uses statistical analyses techniques to provide investment insights to novice investors. Prior services like Stock Recommender relied on traditional models of analyzing historical data which does not account for company valuation or market volatility. My service provides a user-friendly interface that displays recommendations based on historical data and stock valuation metrics which offer a more nuanced assessment of stock potentials. My service is also continually updating allowing users to always receive consistent recommendations under the most relevant information.

4. Brief summary of the service

Stock Recommender provides users with the top 10 recommendations in S&P 500, NASDAQ, and DOW indices while also giving users the insight on the top 10 stocks to consider selling. The scoring system

employed by my service leverages a one-year linear regression analysis, the P/E ratio, and RSI of each stock. Each stock is evaluated within its index to enforce consistency with various statistics.

5. Brief description of the several views of the drawing

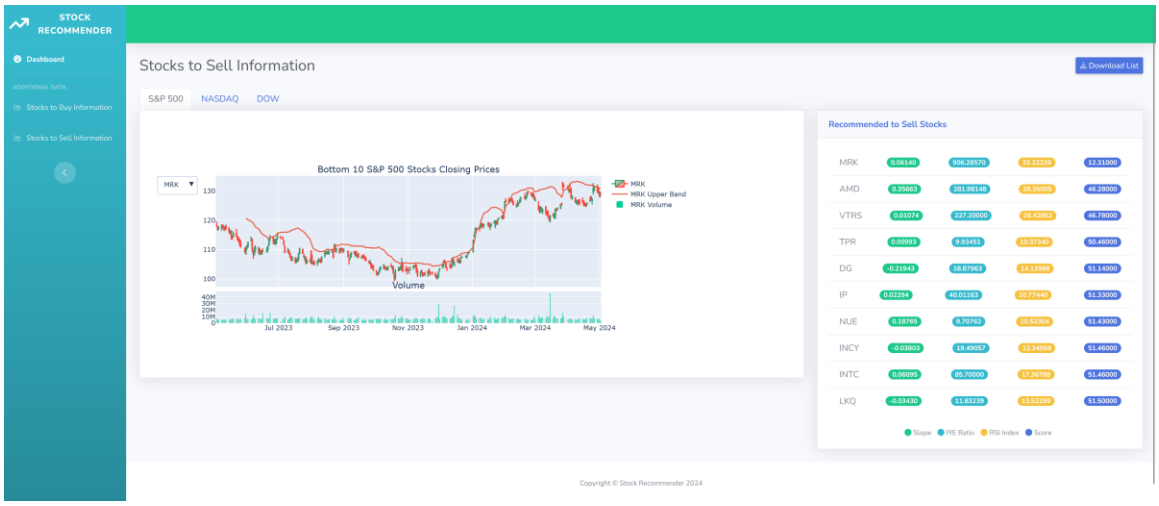


Dashboard

1. Market Summary of S&P 500, NASDAQ, DOW, and RUSSELL.
2. S&P 500, NASDAQ, DOW 1-year performance graphs with an added linear regression line. Users can switch between indices through the tabs at the top.
3. Top 10 recommended stocks with their assigned score.
4. A Download List button that will save a csv file with the recommended stocks to the user's computer.
5. Collapsable sidebar access to 'Stocks to Buy Information' and 'Stocks to Sell Information'.

Stocks to Buy Information

1. Candlestick chart with Bollinger Band and volume profile.
2. Top 10 recommended stocks with information on their slope, P/E Ratio, RSI, and Score.
3. Dropdown menu to select from the list of recommended stocks.



Stocks to Sell Information
This view has the same layout as the Stocks to Buy Information view.

6. Detailed description of the web service

Stock Recommender calculates the 1-year linear regression, 14-day RSI, and the P/E ratio from the trailing P/E and combines them in a weighted scoring system. These metrics are normalized within their indices and specific favor is placed on P/E ratio closer to the average and RSI between 30 and 70. The score for any given stock is as follows:

$$Score = (NormalizedSlope * 0.40 + NormalizedRSI * 0.20 * NormalizedPE * 0.4) * (1.2\ IF\ (RSI \geq 30\ AND\ RSI \leq 70)\ ELSE\ 1) * 100$$

Note that *NormalizedPE* is actually:

$$NormalizedPE = normalize(abs(PERATIO - AVERAGEPERATIO),\ inverse = True)$$

This ensures that P/E Ratios closer to the average are favored. Due to the RSI weights, it is possible attain a score above 100, however this service explicitly caps the scores out at 100.

My service employs a one-year linear regression slope analysis to assess the stock's price trend over time and to identify stocks with favorable positive trends. One year of historical data queried from Yahoo Finance was used because it was a suitable timeframe in which it was neither too short nor too long. A timeframe such as three months would've been greatly affected by any possible noise, thus making it difficult to assess the correct trend. A timeframe such as three or five years would not have been indicative of current market conditions. Many of the stocks were affected by the market slump of 2022 and analysis from the 5-year data resulted in most of the stocks having slopes close to 0. A total of 316 stocks from the S&P 500 Index were analyzed to have less than 0.05 slope with 74 of them being negative. Therefore, a one-year slope analysis is the best timeframe to capture current market conditions.

P/E Ratio is incorporated into my service due to my service's desire to include valuation metrics into its scoring system. A typical rule of thumb is that lower P/E Ratio is favorable, however a stock cannot have too low of a P/E ratio. Additionally, not all stocks with P/E Ratio are unfavorable. After analysis of the standard deviations, first quartile, and third quartiles of P/E ratios within each of the indices it was found that P/E ratios in stocks revolved around the average P/E ratio within their index. Also, the average P/E ratio within indices were also in the lower range making them favorable. As such, my service employed a system that weighted P/E ratios closer to the average more favorably.

The choice to include RSI in my scoring system is due to its indicator of oversold and overbought stocks. It is a helpful metric to determine to assess risk. It was given a 20% weight due to its short-term nature of only 14 days. It is also well known that 70 is the threshold for overbought conditions and 30 is the threshold for oversold conditions. As such, more weight is given to RSIs within 30 and 70.

With the combination of linear regression slope analysis, P/E ratio, and RSI, Stock Recommender can rank stocks and assign them a score that factors in overall trend, valuation, and risk.

The web service itself was created from the following tools:

- Django web framework
- SQLite Database
- HTML/CSS Frontend
- Bootstrap Frontend

The financial API that was used:

- Yahoo Finance API

Libraries that were used:

- Pandas for pulling data from the database and data processing
- Numpy for calculating and normalizing metrics
- Scipy for linear regression analysis
- Plotly for data visualizations

This service was created by first creating tables within the SQLite database to hold the calculated metrics in S&P 500, NASDAQ, and DOW. There was also an additional table allocated to contain the historical data of the top-10 stocks and the bottom-10 stocks from each index. Using Django commands, data was queried from Yahoo Finance API, processed, metrics were calculated, and then data was loaded into the database. I ran into an issue where Yahoo Finance API would time out after consecutive queries, so I created a query function that had an ability to query the data with a set amount of retries and a delay timer. However, this was not enough for stocks within the NASDAQ index. Due to the fact that there are ~3000 stocks within the index the symbols had to be split off into 6 batches and loaded one by one. Scores are then computed in another Django command.

Data is then queried from the views to create the visualizations and present the recommended stocks with their metrics. Initially, information was directly queried from the API to create the candlestick charts in the Stocks to Buy Information and Stocks to Sell Information pages, however querying the API takes a long time and oftentimes timed out. As such information was then loaded into the additional table in the database which only contained historical data from the presented stocks. Querying from the database was much faster and much more reliable.

The views themselves were created with Bootstrap which was extremely helpful since this was my first time working with HTML, CSS, and Django. Plotly plots were passed into the views, however the plots in the NASDAQ and DOW tabs had trouble auto resizing due to hidden tab attributes. As such, I wrote a script that would trigger the auto resize on the plots after the tabs had loaded. The Download List button queries the Yahoo Finance API in real time, so it does run into the issue of timing out, but it usually only requires a reloading of the page.

The Stocks to Buy Information and Stocks to Sell Information pages contain a candlestick graph with the selected stock's open, close, high, and low. It also contains a volume profile at the bottom. Stocks can be selected through the dropdown menu on the left of the plot. The list contains all of the stocks that are recommended within the index.

7. Evaluation

Stock Recommender provides a novel scoring system incorporating linear regression, P/E ratio, and RSI. As such it is difficult to find similar services that provide the same analysis off the same metrics. Because this approach is unprecedented, my service provides visualizations like the candlestick graph to let the user decide for themselves whether to agree with the scoring system.

However, the initial project goals were to create a dashboard with market summaries, suggest stocks to buy and sell, and to display visualizations. These success metrics were all met. Additionally, the web service was also tested on performance and the results are satisfactory. The load times into the Stock Information tabs is acceptable.

Stock Recommender has a simple and clean interface that is user-friendly while also capable of displaying important information to users. While the validity of results is difficult to measure, it is worth considering my approach of fusing historical data analysis with valuation metrics and risk indicators.

8. Claims

1. A computer implemented method for providing stock recommendations, the method comprising of:
    - using an API and accessing financial data on the stock indexes of S&P 500, NASDAQ, and DOW;
    - calculating a score for each of the stock indexes based on:
        - a 40% weight on the slope from a linear regression analysis on historical stock data;
        - a 40% the price-to-earnings (P/E) ratio of each stock favoring those closer to the average;
        - a 20% and the relative strength index (RSI) of each stock, favoring RSIs between 30 and 70;
    - ranking the stocks based on the calculated scores;
    - selecting and displaying the top ten stocks and the bottom ten stocks on a user interface of a website.