Financial Portfolio Enhancement Using Machine Learning and Artificial Intelligence

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Abstract **- A surplus of income over expenditure has created a demand for a variety of investment options, depending on the consumer's appetite for risk, desire for returns, and need for liquidity, among other non-quantifiable characteristics. This gave rise to the concept of a portfolio, which is simply a collection of assets or avenues for investing money, as well as the allocation of funds to each of these assets.**

Cash, equities, real estate, fixed income, and commodities are the most prominent of these options. Each avenue has its own set of valuation principles and meets a different set of needs for employers. We're looking at portfolios that include both equities and fixed income for our research. For fixed income, we use an amortized rate that is considered to remain constant over time. The S&P 500 index is made up entirely of stocks. Machine learning is used to choose stocks and distribute capital appropriately. The user's risk profile is taken into account when calculating the fixed income allocation.

Index Terms **- Liquidity, Machine Learning, Portfolio, Allocation, Mathematical Modelling.**

I.INTRODUCTION

People have experienced excesses and deficits from the beginning of the barter system, long before the concept of currency was even conceived. These were then bartered to get the commodities they needed and get rid of the ones they didn't. However, it was not always possible to find interested trading partners.

To avoid this dilemma, they would instead lend it to a third party who would provide security and match partners in exchange for a modest percentage of the profits. People began to offer money to merchants in order to purchase stockpiles of commodities in areas and periods of abundance and sell them at a higher price in regions and times of shortage. This was the first type of resource investment. When money became widely used, people strove to set aside a portion of their earnings and invest it in a way that they could see it grow, or at the very least maintain its worth.

This was initially housed in banks, but a flaw was quickly uncovered. Lenders received a substantially low rate of interest from banks. With the passage of time, continual inflation eroded the value of their investments, which were already earning negligible interest.

Thus, investors began to look for other avenues to invest their savings in. One of the most prominent of these came to be known as the stock market.

The concept of a stock was born out of the desire to own a piece of a corporation. Owners of businesses have realized that the costs of starting and running a business are too expensive for them to handle on their own. As a result, they devised the concept of corporate part ownership. Some stake in the company would be announced and then diluted to a small fraction by breaking the capital required into shares.

As a result, each share represents a minuscule portion of the company's ownership. As the company's value increased, so did the value of the shares, making them a more valuable property than before. Current supply and demand guided the price of the shares, with current events significantly impacting the short-term price levels of the share.

As a result, the art of trading was born. Trading could be defined as buying a stock which was expected to change in price in the near time frame and sell it off at the right time to earn profit on the difference.

II. LITERATURE SURVEY

Objective of this review section is to present literature survey of portfolio management methods. The main goal is to highlight advantages and limitations of these methods.

Paper-1: Mean-Entropy Models for Multi-Period Portfolio Selection with Multi-choice Aspiration Levels

Mukesh Kumar Mehlawat discusses the different mean-entropy models responsible for dictating the portfolio choices for different classes of investors. This classification is based on aspiration levels, which can essentially be summed up as the type of rewards the investors are looking up, combined with the time horizon for which they are investing the amount, and lastly but certainly most importantly, the level of risk the investor is ready to partake in without removing his investment from the account.

Paper-2: Asset Market Participation and Portfolio Choice over the Life-Cycle

Andreas Fagereng et al. is a qualitative paper which primarily discusses the asset market participation of investors at different ages. Following this, the type of investments made by different participants from each category is analyzed and observations are made on the amount of risk that is taken by participants in different stages of their lives and the instruments picked by them to invest their savings.

Paper-3: Portfolio Allocation for Bayesian Optimization

In an approach to quantify the art of investment, Matthew Homan et al. discusses the approach of portfolio allocation, which can be defined as deciding the fraction of the investment to be invested in each instrument or security that we pick.

The paper quantifies this approach and achieves it by essentially generating an initial portfolio and then maintaining it by using the approach of Bayesian Optimization to try and generate market beating returns.

Paper-4: Virtual currency, tangible return: Portfolio diversification with bitcoin

Marie Brière et al suggests an approach which is commonly used but provides a different viewpoint on it. It discusses the approach of diversification, which boils down to investing savings in different avenues, to ensure that an unlucky event doesn't wash away all the savings on our part.

Instead of traditional assets, which might be correlated with each other, the author suggests an approach of diversification with cryptocurrency in general and Bitcoin in particular.

Paper-5: Learning to Optimize Profits Beats Predicting Returns -Comparing Techniques for Financial Portfolio Optimization

Wei Yan et al. serves numerous purposes. One of them is that it acts as a review paper, discussing the currently existing approaches to portfolio optimization.

It then supplements this with further optimization techniques derived from genetic programming and compares the results of such approaches to those of the traditionally existing approaches to optimization.

III. METHODOLOGY

The data is downloaded through the Yahoo Finance API at first. This API allowed us to collect information on the stocks that are now trading, as well as their price-volume values for the previous five years. This is the information that was used to train the model. After the system has been set up, the first step is to take the user's Risk Profile.

The Risk Profile refers to values taken from the user indicating the amount being invested, the minimum amount the user expects to make and the amount the user is willing to forego in case of a downfall within the market.

The risk profile helps the system obtain a better understanding of the user's expectations.

It also gives the system a sense of the user's risk tolerance. The user's risk appetite is defined as his or her readiness to take risks. Risk-averse or risk-loving users are both possible. For example, out of a 1,000 investment, someone willing to risk 900 is a risk lover, while someone willing to risk only 100 is a risk averse. The risk profile is then calculated using the basic formula for fixed income and compound interest. The amount to be earned, for example, can be calculated by multiplying the principal by the rate of interest to the power of the time period. We got the number that represents the minimal amount the user expects to make, say A, by subtracting the total amount from the maximum amount the user is ready to forfeit.

This value is then invested in a risk-free asset in order to meet the basic criteria of generating the desired minimum amount. Using A, the system determines the principal amount to be invested in that specific risk-free asset, using r as the bond's interest rate and n as the time period for which the investment is being made.

This principal sum is then removed from the total amount being invested, with the remaining funds being put in the stock market. The next step within the system is to visualize the data for the stock. This is when the system tabulates the data it has regarding the stock.

This data includes information regarding the stock's highest values in the previous day, its lowest values, the number of times it was involved within a trade and rise or fall from the previous day.

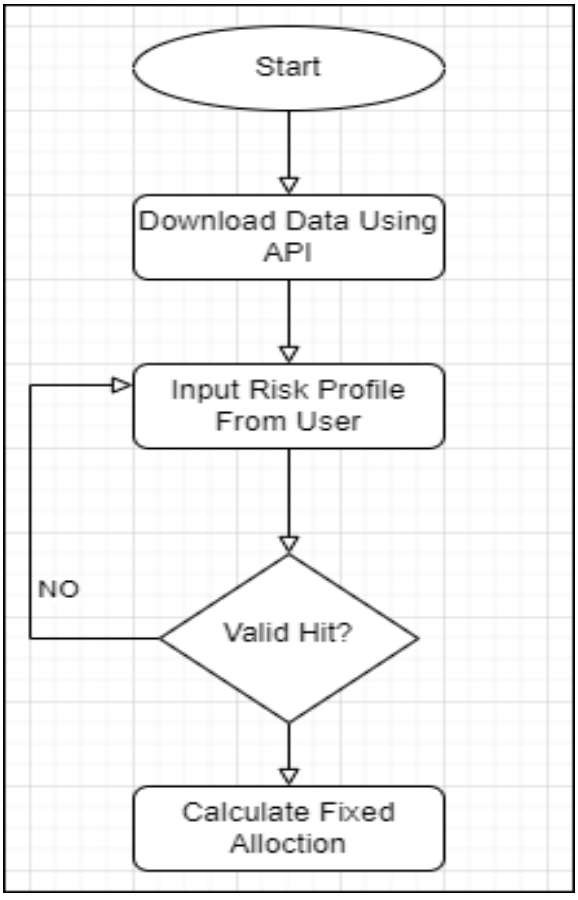

Fig 1.1 Data Acquiring and Risk assessment Flowchart

The dataset hence generated, is then split. The system is trained on a portion of the dataset. As a result of this training, the system will be able to reliably estimate the future values of other stocks. Normalization and standardisation of the tabular data follows.

The data for a single stock is converted to fractional values by normalising the data. Following the same approach for all other stocks in the dataset, the data is standardised. As a result, the stocks generated as output are the ones that the algorithm recommends for investment. These equities are then given weights based on their profitability.

The stocks with higher profit will have a higher weight as compared to the stocks offering lower profit margins. This weight is determined using fractional numbers ranging from 0 to 1. This is accomplished by adding all of the values together and dividing the stock's value by the total. These weights are then taken into account when selecting stocks to invest in.

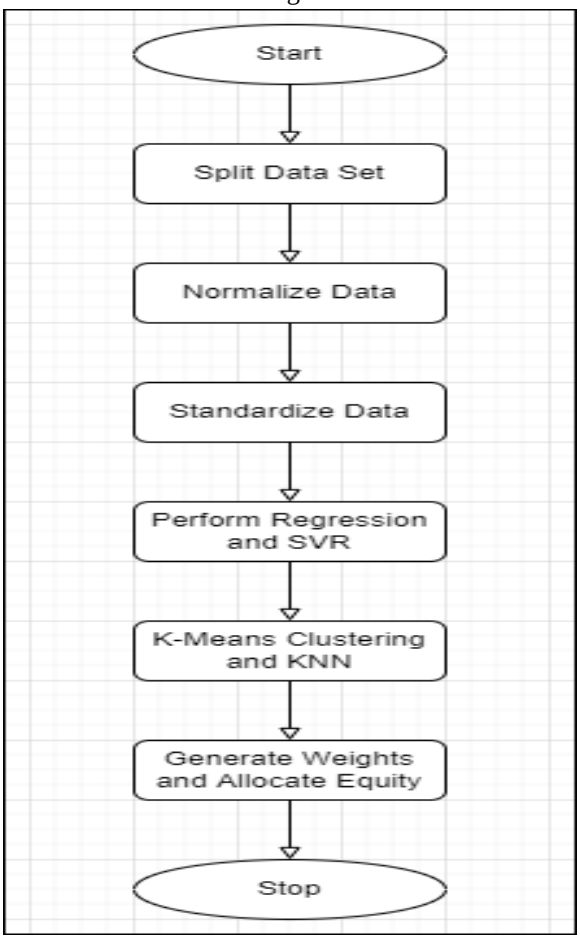

Fig 1.2 Portfolio Analysing Flowchart

After then, the Sharpe Ratio is calculated for all of the stocks. It aids investors in comprehending the relationship between risk and return. The Sharpe Ratio is a measure of how appealing a security is to investors. The greater the Sharpe Ratio, the more

appealing it is to investors. The returns are plotted on a graph once the stocks have been chosen.

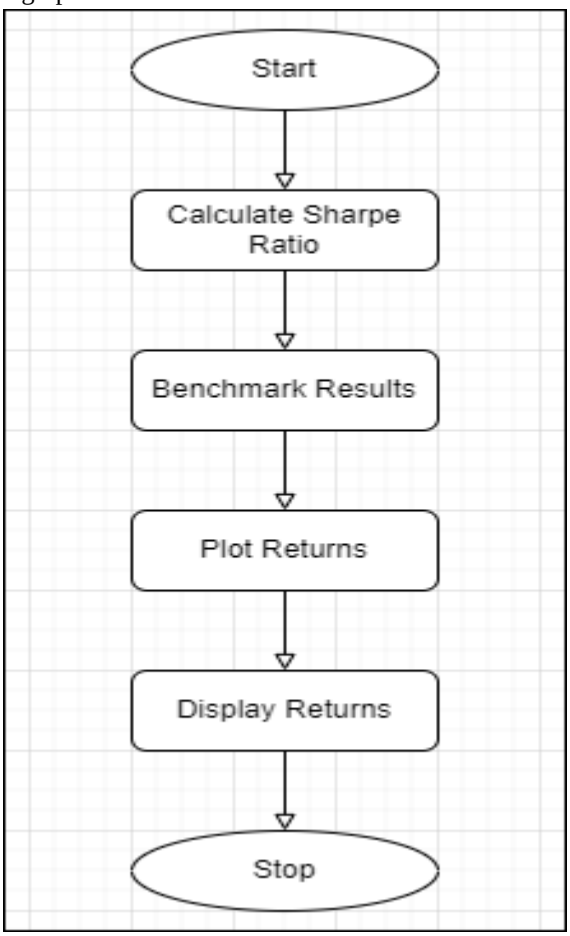

Fig 1.3 Benchmarking using Sharpe Ratio Flowchart

Various experts can examine this graph in a variety of ways. Aside from the graphs, the system also produces data that explains how much money should be put into safer assets like bonds and how much should be put into riskier assets like stocks. Aside from that, the system estimates how much money it will make in total.

IV. CONCLUSIONS

The project was created with an objective of developing an improved investment system for investors who needed safety from adverse events wiping out their entire portfolio, as well as a significant rate of return higher than that of the market in the same time period. This involved generation of a portfolio with two distinct components: the fixed income component for capital preservation and the equity component for enhanced returns.

It was observed that the system performed significantly well, generating returns much higher than the market returns for the same time period, and helped observe the list of equities which were responsible for the remarkable growth of the portfolio. The fixed income component took account of the user's risk profile and accordingly invested an amount just enough to generate enough returns to cover the risk profile even in the adverse possibility of losing the complete capital in equities themselves.

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