



MAXIMO: A GOAL-BASED PORTFOLIO MANAGEMENT AND FINANCIAL PRODUCT DIVERSIFICATION APPLICATION

NEHAL SURTI, MUSKAN SAHU, SAUMITRA CHASKAR,
NATAASHA RAUL and N. MEGHANA

Department of Computer Engineering
Sardar Patel Institute of Technology
Mumbai, Maharashtra, India
E-mail: nehal.surti@spit.ac.in
muskan.sahu@spit.ac.in
saumitra.chaskar@spit.ac.in
nataasharaul@spit.ac.in
meghana_naik@spit.ac.in

Abstract

In India, financial planning is considered to be a complicated concept. Most of the people are neither aware of the different investment options nor well off to pay the exorbitant fees of professional financial advisors. We propose MAXIMO, an application that provides tailor-made advice based on the user's income structure, expenditures, responsibilities, risk sensitivity, and goals. The application will diversify the user's capital into varied instruments of investments like Government and Corporate Bonds, Mutual Funds, Stock Market, and Gold. Machine learning-based prediction techniques are used for predicting the future values of these instruments. The proposed application is a means to provide customized financial planning to people who don't want to take any undue risk but still thrive to achieve their financial goals.

I. Introduction

The Indian financial market is highly diverse and it is undergoing continuous growth, in terms of an increase in the existing as well as new and emerging financial services. By 2028, India is expected to be in the top four positions as the largest wealth market in the world [1]. The financial market

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in India includes various sectors. The problem that the majority of the Indian population faces today is about how to save and invest their existing earnings. Limited financial literacy and awareness and preconceived notions about the financial markets are the major barriers that stop people from achieving complete financial freedom. Technology and finance still have a long way ahead wherein the mixture of these two domains can be very helpful for people.

Financial Product Diversification refers to a risk management strategy that involves the creation of a portfolio by selecting a variety of investment instruments. Such a portfolio will contain a wide range of assets and investment vehicles to limit exposure to a particular asset or risk [2]. This strategy reduces risks in a scenario of an industry downturn and provides for a wider scope in terms of variety and options. A diversified portfolio, when compared with an individual holding, on average, provides for lower risk and yields a higher long term return.

The solution provided in this paper is an integrated platform where all the mentioned issues are resolved. The application provides an easy-to-use interface for the users to input their financial goals and their financial standing to get a tailor-made financial plan according to their risk appetite. Datasets needed in this application have to be reliable, accurate, and updated in real-time. Hence the datasets are gathered by web-scraping (a technique used to automate the extraction of structured data from web-based documents).

II. Literature Survey

Savings and Investment are the two key factors for achieving and maintaining high economic growth. While land holdings occupy 84% and gold investments occupy an 11% share in the Indian household's investment portfolio, financial assets account for a meager 5% which is very less compared to the other developing nations where there is a substantial holding of financial assets [3]. The skewed financial investment approach can be attributed to two factors like lack of reliable information and market access, lack of financial literacy. The Indian household investments are very much limited to bank fixed deposits and some standard savings schemes like

Post Office deposits etc. [4]. For risk mitigation, diversification of investments is considered across five sectors of Gold based Investment, Bonds investment, Stock Market investment, Mutual Funds investment. Analysis of relevant work in each sector is discussed in brief.

In [5], Decision Tree, Support Vector Machine, K -Nearest Neighbour, and Linear Regression is used to predict the gold price movements through attributes of weekly data of Gold Funds. The results show that the KNN algorithm has acceptable performance. In [6], [7], the data is collected from the database maintained by the Reserve Bank of India. The study analyses by taking the average of the gold price of every month in a year. The results show that a decrease in the supply of gold, a fall in interest rates, an increase in inflation, a decline in dollar values affect the increase of gold prices.

A new method of stock market time series data mining is presented which combines RNN with the Rough set in [8]. They have demonstrated their proposed algorithm on the stock database from the Shanghai Stock Exchange over three years from 1998/1 to 2000/12. The rules discovered as a result of this were much more amenable to human comprehension and prediction accuracy is high for the stock market making it useful for investment decision support. [9] Discusses the different strategies used, their input, advantages, and disadvantages concerning its application in predicting market trends. They observed that it is essential to choose an algorithm as per the framework by which the accuracy of the system can be maximized with fewer computational complications. They recommend using cross methods according to the above-stated factors.

The paper [10] uses DEA (Data Envelopment Analysis) for finding the best and most efficient mutual funds in their respective categories. The results are compared against the CRISIL and Value Research ratings for the mutual funds. The results of the paper show that 74% of the funds recommended by the approach fall under the above-average category and are stable. The paper [11] implemented the cascaded SVM model (SMO regression) based system for predicting NAV (Net Asset Value) of a mutual fund scheme. The data used for training was the two-year Close prices of the stocks under that particular scheme and the testing data was for one year. The NAV was predicted based on the performance of the stocks under that scheme. The results were demonstrated in terms of MAPE value which was

about 0.29%-0.36%. However, the prediction window was less than 1 year which is comparatively shorter for mutual funds investment in which the user usually remains invested for longer terms of more than 5 years.

The paper [12] talks about using Support Vector Regression (SVR) for bond price prediction and also compares the results with a Neural Network (NN) model. The results show that SVR performs better than the NN model with a lesser MSE value and a greater r squared value. The prediction is however done on a shorter time frame of 10 months while bonds usually have a tenure of more than 5 years. The paper [13] proposes a clustering algorithm for corporate bonds. The dataset used is from a Portuguese retail bank. The paper concludes that the K Means algorithm works best for clustering bonds based on their price, maturity, etc.

III. Implementation Methodology

The economic slowdown has adversely affected middle-income families. They are generally left with little money in hand to meet their goals. They must make smart decisions to make most of the money by sustainable investment to fulfill their financial goals. In consideration of the above discussions, we propose MAXIMO, an intuitive app that will be able to solve the aforementioned problems effectively. The various modules and features of the app are discussed here.

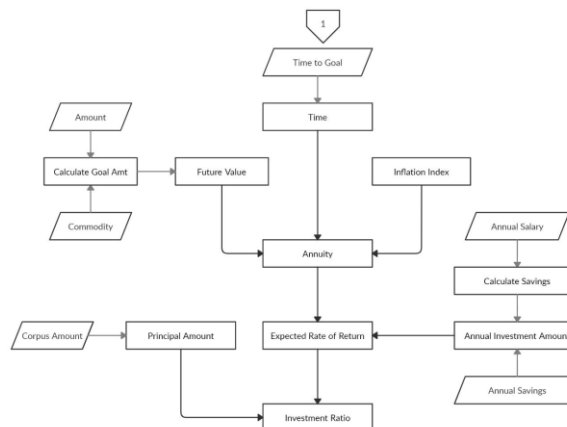


Figure 1. Data flow in the portfolio manager module.

A. Portfolio Manager

The user interacts with this module to obtain investment recommendations based on his financial conditions, expected goals, and risk tolerance. The user is expected to provide the following inputs:

- Goal amount: expected amount at the end of investment tenure
- Annual investment: the amount the user can commit annually to this goal
- Time: tenure of the investment
- Risk tolerance: a measure of how risky investment is permissible to the user on a scale of 1-5

The app obtains the future value of the goal, expected annuity for the goal, and expected rate of return from the investment by applying standard financial formulas on the input provided. The app further uses these values to calculate the investment ratio for the user with a given goal. This flow of data and its processing is depicted in Figure 1.

The app considers six major sectors most likely to receive investment by middle-income families, namely Fixed Deposits, Bonds, Mutual Funds, Gold, and the Stock Market. While calculating the investment ratio, the expected rate of return for each of the above sectors, and the risk of loss associated with the same is taken into account. The investment needed in each of these sectors is calculated as follows:

1. All sectors with risk levels above the user's risk tolerance are ignored.
2. The sectors with an expected rate of return higher than the required rate of return and risk of loss less than the user's risk tolerance are given twice weightage.
3. The remaining sectors are given a single weightage.
4. A ratio is calculated using these weights for each sector. This ratio is further applied to the annual investment to obtain the amount needed to invest in each of these sectors every year.

All of the sectors mentioned above have their independent modules of recommendations with the app. The investment amount obtained for a sector

is sent to the module of that sector to get the best recommendation within that sector for the investment at the point in time. These recommendations are displayed to the user. The working of each module associated with the sectors is discussed in the following sections.

B. Stock Market

In the case of stock market predictions, the user will have the choice to either see the future value of a particular stock or the stock recommendations for maximizing a given investment. Dataset web-scraped from <https://www.nseindia.com/market-data/live-equity-market>. The user opts for this option when he wishes to see the returns on a selected stock or when he wants to check the future trend for an already sealed investment. The working of this subsection is as follows:

- **Input:** The user enters the name of the stock and the tenure of investment.
- **Prediction:** The name and time is used as input to the ARIMA model to predict the future price of that particular stock
- **Returns predicted:** Future value of the stock is displayed along with the trend and associated information.

C. Mutual Funds

Mutual Funds are emerging to be one of the most popular modes of investments across different income classes. The vast number of mutual funds in the market makes it difficult for investors to choose the best fund for them. But having a good idea of one's investment objective, risk appetite, and preferred investment tenure can help the investor to narrow down the long list of schemes to a few schemes that align with their goal. Dataset web-scraped from <https://www.valueresearchonline.com/funds/>. The user can interact with this module in the following way:

- The user will choose from the broad categories of mutual funds schemes, available in the application, as per his investment objective.
- The user then has to enter the time for which he wants to remain invested in the fund and the amount to be invested.
- The system will then display all the suitable schemes to the user along with their rate of return and expected growth in their invested capital.

Before displaying the mutual fund scheme alternatives to the user they will be filtered based on their credit ratings either by CRISIL or Value Research, their expense ratio, and Sharpe ratio and only the best schemes will be recommended to the user.

D. Gold Investments

One of the major sectors in which a middle-income family invests is gold. Gold is seen as the safest investment by many. Its negative alpha also dampens the losses in the stock market. The working of this module is as follows:

- The current price of the gold per 10g will be shown to the user.
- The user is asked to give the input of how much weight of gold they are interested to invest in.
- The system will then calculate the price of the given weight with respect to the current price to give the user the total amount they need to spend to buy the gold.
- The user then needs to put the time period for which they want to invest.
- The system will then give this input to the ML (ARIMA + Polynomial Regression) model and predict an estimated value of the interested gold weight after the given time.
- The ML model will take into account factors such as historical prices, time period, inflation rate, USD exchange rate, and festive season.

E. Bonds Investments

The bonds sector is an extremely viable yet untapped investment sector for middle-income households. The main reason behind this is the lack of information regarding this sector. It's inclusively within the app that will increase awareness for this relatively safe and sustainable sector. Dataset web-scraped from <https://www1.nseindia.com>. The working of this module is as follows:

- The user has to provide the investment tenure, investment Amount, and also the risk associated with the investment that the user is willing to make.

- **Decision Making:** The Decision Model will take into account the above-mentioned parameters and recommend the appropriate bond types.

- **Bonds Option:** The system will then display the different options available in the recommended bond types.

- **Bonds Selection:** The user will then select the bond which interests him and the investment procedure for that particular bond will be displayed to the user.

IV. Results and Outcomes

The application that we developed, MAXIMO acts like a personal financial assistant that gives tailor-made advice on the investment amount, domains, and tenures taking the user's goals, investment capacity, expected returns, and tenure of investment into consideration. MAXIMO successfully obtains the following outcomes:

- **Future Value Prediction:** Future values for sectors like Stocks and Gold is predicted and an estimated valuation of the investment is displayed.

- **Recommend Bonds and Mutual Funds** based on user requirements

- **Building a Balanced Portfolio** based on user risk profile and investment capabilities:

Beyond these, MAXIMO is simple to use and accommodates within a small storage space. The result of each outcome is discussed further.

A. Prediction Modules

The prediction modules are the ones that make use of machine learning algorithms to predict the future value of the specified commodity in that domain. MAXIMO has two prediction modules- the stock market and gold. The stock market module predicts the future value of stocks listed in the Nifty50 stock index (a popular index that has many well-known and frequently purchased stocks). The mean accuracy among all stock predictions is obtained as 89%. The gold module predicts the future value of gold with respect to its pricing in the city of Mumbai. This prediction module provided for the accuracy of 83% and returned the resultant prediction in a maximum of 13 seconds.

B. Recommendation Modules

The recommendation modules take user details and requirements to filter and choose the best alternatives to recommend a list of possible investments for best returns. MAXIMO has two recommendation modules- Bonds and Mutual Funds. The Mutual Funds module considers all major mutual fund houses within its scope to recommend the best results within the risk tolerance and the maximum tenure provided by the user. The execution time for this module is observed to be 8 seconds in the worst case. The Bonds module recommends the best results within the bond category that suits the user's expected return, risk, and tenure requirements. The execution time for this module is observed to be 15 seconds in the worst case.

C. Portfolio Creation

The responses to the survey forms that were circulated for understanding the behavior of middle-income users concerning investing were analyzed to obtain insights. These insights were further used in the portfolio creation module to fine-tune it for the target users. The form collected users' annual salary and annual savings. The ratio of these two was calculated and grouping was done. This ratio was rounded off to the nearest multiple of 0.05 and then used to calculate annual investment for a user from his annual income during portfolio creation.

The form collected the users' risk tolerance on a scale of one to five and the domains in which he has invested to understand the domains that are likely to come within a particular risk domain. This information coupled with the risk premium of each of these domains was used while dividing the investment amount among the various domains.

The portfolio created will consist of a timed investment plan along with the amount of money to be invested in each domain. This portfolio created is entirely based on the user's goal, investment capacity, risk level, and tenure. Moreover, this portfolio is not prone to erosion as inflation is taken into consideration. The worst-case execution time for this module is 18 seconds, 7 seconds for investment distribution, and remaining for an individual module running.

V. Conclusion

The aim of our research was to provide a solution that will assist an individual in their financial planning by helping them make an informed choice about investing in different sectors for attaining his/her financial goal. In order to understand the problem at hand at a greater depth a rigorous survey on all the different sectors pertaining to the field of finance and around and about our scope of analysis was conducted. The research was done to understand the different systems currently used in the above-mentioned sectors for the purpose of analysis, predictions, estimations, and recommendations of products and services. We also found out that all these finance sectors which are currently analyzed as isolated sectors can be analyzed together as a whole for enhancing the customer's approach towards financial planning.

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