AI-based Financial Advisor for Stock Market Predictions using Cloud

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Abstract*— *The research paper intends to improve the existing personal finance advisors leveraging AI techniques for stock market investments by solving a few critical problems noted in the current systems. The main objectives consist of improving the flexibility and the creativeness offered by the algorithms, enhancing data security, data coupling privacy concerns, and fully eliminating algorithmic prejudices to fairer and unbiased recommendations. Further, the specific orientation of the research is also connected with strengthening the explainability of AI models and their orientation towards regulatory standards aimed at increasing investors` confidence, as well as enhancing the predictive accuracy of the models by incorporating behavioral finance. With these improvements in place, the research is aiming to deliver a more trustworthy, safe, and consumer oriented AI powered financial advisory platform.

Keywords— ***Artificial Intelligence, Security, LSTM, Cloud, Financial Decision.***

I. Introduction

Considering an ever-growing volume of information about income, expenses, taxes, loans and investments one must manage his or her personal finances in today's world, one must realize how crucial it is to come up with a good financial plan. Short-term as well as long-term financial goals are necessary for success, but these markets are also unpredictable. Of course, financial advisors have been an important part of the clients´ journey in such cases, advising on financial behavior or trends that needed to be followed. On the other hand, both are often expensive and involve the risk of having to keep up with market rates which might be prone to volatility all the time. The introduction of technology however has changed the financial industry tremendously such that reliance on consultants is not as necessary. Applications and online tools for AI (Artificial Intelligence), which constitute a form of machine learning (ML), have been created for the automatic management of personal finances as well as recommendations on investment.

Nonetheless, there are still issues such as safeguarding data, eliminating algorithmic bias, and making the recommendations clear and easy to explain. Furthermore, in this context, as demand for such solutions continues to grow, cloud computing has emerged as an essential platform for AI-based," robo-brokerage" systems. Cloud computing resources make it possible to pursue round-the-clock monitoring of financial markets and deploy AI algorithms in a reliable and scalable manner. In respect to this research paper seeks to construct AI based personal financial advisors hosted on cloud resources. The main goals towards which the system is directed include provision of accurate financial counsel by addressing a number of challenges such as data security, bias and transparency using the scalable features of cloud infrastructure. Thus, as part of this study, we strive to further develop the theme of AI in financial services and show new opportunities for the market generated by cloud technologies for providing affordable and secure financial consulting.

II. Related Work

Hui Zhu et al. [1] wrote a literature review and a stimulating perspective on how AI-enabled financial advisory services should be developed, stressing the disruptive potential of these services on human advisors in the retail investment market. Priyanka R. Rao et al. [2] addressed the role of

fintech innovations such as robo-advisors in the sphere of personal finance, emphasizing their low cost and ease of use and evaluating their effects and some disadvantages on the behavior of investors. [3] summarized the use of Generative AI in financial decision-making, focusing on risk assessment, investment choices, and financial analysis, while considering the challenges of adopting GAI in finance. [4] discussed the role of Generative AI in virtual financial robo-advisors, exploring how AI can provide personalized asset management solutions and the importance of transparency and trust-building in such systems Zengyi Huang et al.

Sergiu-Alexandru et al.[5] reviewed the impact of advanced data management technologies in transforming financial decision-making, with a focus on the evolution of data storage and processing in the finance sector. [6] analyzed AI's positive impact on finance, including risk management, trading, and fraud detection, and discussed the challenges and ethical considerations Marko Ranković et al.M. F. Anshari et al. [7] have suggested a model where robo-advisors are integrated with digital twins for better personal financial management. According to J.K. Hentzen et al [8], with regards to AI applications in customer service activities, have conducted a systematic review, pinpointing research gaps and stressing the dichotomy between data-centric and theory-centric approaches. Implying the integration of AI in Islamic finance, S. Khan, [9] proposed an AI and NLP based chatbot which provides real-time Islamic finance advice This was the first of its kind applicable in Islamic Banking and finance. Balaji Dhashanamoorthi [10] gave an in-depth presentation on the application of AI within the banking and finance industry addressing the issues of cyber security and cybercrime but related to non-usual personal finance advisory services. A. Bhatia et al. [11] defined the understanding and recognition the Indian investors have about robo-advisors regarding their factors such as cost effectiveness while trust and data security appeals to adoption.

Manchuna Shanmuganathan [12] incorporated the effects of behavioral finance on the investment decision process through the use of artificial intelligence based robo-advisors. Alison Lui et al. [13] outlined an 'augmented intelligence collaborator', which can be used as a model of AI regulation that would help to regain trust towards the financial services sector. J.A. Al-Gasawneh et al. [14] studied the adoption of AI in the financial services context focusing on security perception, endorsements and perceived risk intensity and relationship. L. Fan et al. [15] have placed the diffusions of innovations and information search models as frameworks in the context of robo investors. [16] P. Gomber et al. interpreted the forces of innovation disruption and transformation in the financial services industry which was emanated by the fintech advancements. [17] systematically reviewed literature on AI in customer interaction in financial services and suggested future research opportunities J.K. Hentzen et al. [18] T. Kraiwani et al focused on the social acceptance of financial robo-advisors in the context of developing countries and explored some of the determinants. D. Kwon et al.[19] performed empirical investigation regarding the factors affecting the intention to utilize the service of robo-advisors. D. Belanche et al. [20] addressed the adoption of AI in fintech: users' attitudes towards robot advisors.

III. Proposed Work

A. Problem Description

According to our research, the stock market is affected by great risks since the prices of the stocks are subject to changes and they are somewhat unpredictable and volatile. Even if automated investment recommendations are offered by newly available AI-based financial advisory systems, it has issues of being able to expand, process real-time data, and even forecast accurately. In addition, problems like data privacy, bias, and transparency of an algorithm still exist in several AI models, impeding their widespread proliferation. Weil Research seeks to leverage cloud computing to construct a convincing, trustworthy, and effective AI financial advisor that rectifies these challenges in stock market investments.

B. Proposed Architecture

- Stock Prediction System is used to forecast the movement in the stock market using several machine learning models and algorithms. They will deal with forward price movements of the stock, time series trends of the market, or even exposures, watching price actions in the context of the level of volatility in the market with the graph of stock in motion.

  The Stock price forecasts, stock price movements, trends and stock performance reports are realized based on input which is historical stock data YFinance DB stock.

- The use of trained ARIMA model is very common in social economic time series forecasting which indeed finds use in stock forecasting across various parameters in regards to the available stock market data and historical stock data.

  Data for time series is cut or posted out from YFinance DB time series for the predictive decision of the new stock price.

- Random Forest Regression is a supervised machine learning method that consists of creating a multitude of decision trees in a "forest" to evaluate and predict any value that is constantly changing continually such as the price of stocks or any cryptocurrency. This regression method would be however possibly implemented alongside the ARIMA model in order to boost the accuracy of the predictions.

  The algorithm also incorporates historical stock data as input for the purpose of forecasting stock performance with increased firm adequacy in comparison to single models.

- Stakeholders of the system perform stock price predictions on multiple cryptocurrencies using the trained ARIMA model and Random Forest Regression in the Crypto-Currency Performance Analysis System and other Analysis Systems of the module.

  Data from the YFinance DB is taken which provides trend predictions, volatility assessments, and risk evaluation.

- YFinance DB (Yahoo Finance Database) is the core financial data source for historical market data related to stocks, cryptocurrencies, and other financial instruments. YFinance is well known for providing a wealth of publicly available financial data, including historical prices, volume, company fundamentals, and market indices.

  With the help of financial data available from Yahoo's finance platform, data informs the stock prediction system, the crypto currency performance analysis system as well as other financial modules.

- On the other bipolar axis the AI and Advisory Layers is the core advisory unit of the system where it ingests data from the stock, the cryptocurrency and the forex markets. In this case, models such as the ARIMA and Random Forest models are used to make targeted suggestions to users.

  This system takes as input expected stock prices, cryptocurrency performance, trends in forex and some financial highlights amongst other things and returns customized investment recommendations with intelligence on the risks associated with them.

- Finance ChatBot is an AI chatbot that uses the LLM + GPT-4 to handle user queries about financial markets, stocks, cryptocurrencies, mutual funds and forex. The chatbot will understand user inputs and respond based on the insights generated by other components in the system.

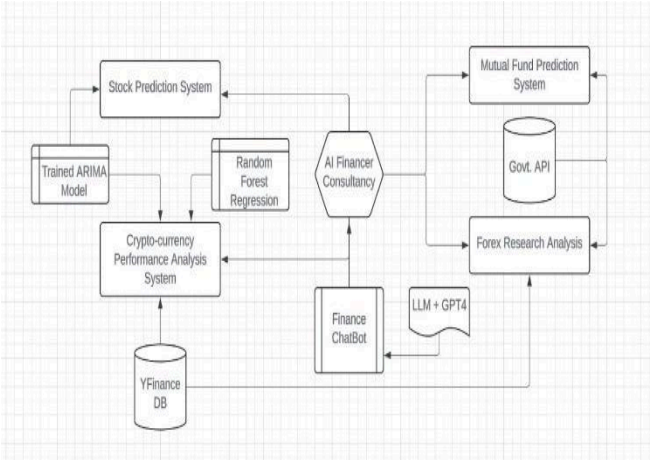
  User queries and requests for financial advice are added to the chatbox and provide detailed financial advice, stock or cryptocurrency predictions, risk analysis, and general market insights.

- Govt. API is likely a government-provided interface that gives access to official data related to financial markets, interest rates, economic indicators, and regulations.

  Real-time and historical data from government sources(eg., regulator bodies, tax authority, etc.) are added which provides updated financial information used for predictions and research (e.g., for mutual funds and forex).

- Forex Research Analysis is to analyze the Forex (Foreign Exchange) market, which handles predictions and risk assessments related to currency trading. The system uses AI models and government data to provide insights into the volatility and potential returns of forex investments.

  Data from the Govt. API, external market data sources, and forex trends are added and forex trend predictions, risk evaluations, and investment opportunities are given.



C. Algorithms

ARIMA

(Auto Regression Integrated Moving Average) is employed for analyzing the trend in stock predictions because of its efficient modeling of time series data with the existence of trend, season, and statistical events. Historical data are obtained from different sources and after that uploaded to a cloud platform where massive amounts can be stored, ensuring its accessibility in connection to model training. Differencing and some other preprocessing techniques must fulfill the condition of making the series stationary as ARIMA requires this condition. The training of the model is done with cloud services taking maximum advantage of cloud computing in tuning model parameters, such as p, d, and q, representing the autoregressive order, degree of differencing, and moving average order, respectively. Using the methodologies of grid search within the general framework of cross-validation to adjust the model parameters, the accuracy of the forecasting is assured. The trained model is deployed by the use of Streamlit Cloud, so as to offer stock prices forecast predictions in real-time. The user inputs the stock symbol and gets forecast predictions for high and low future stock prices based on the prediction model, capturing the short-term market atmosphere. Once deployed on the cloud, the model can be made fully scalable, and it can incorporate new data continually for accurate predictions in a fast-paced market. The research reinforces the adequacy and responsiveness of the system for stock market investors and offers ARIMA calculations with cloud computing.

ARIMA Calculation for Stock and Investment Predictions

When ARIMA is used for stock and asset price predictions it operates in the following way:

- Stationarity: Stock prices are largely non-stationary, that they contain trend or seasonality over time. For the use of the ARIMA model, the data needs to be stationary. Typically it has been done by differencing: subtracting the present value from the last value. Trends are removed, which makes the series easier to predict.
- Setting AR and MA Terms: The AR terms enable the model to learn from previous patterns of price movements, such as lagged returns or price levels. The MA terms then help to correct the noise or shocks present in the time series, such as large jumps in price as caused by market events.
- Forecasting Future Prices: After the model parameters are estimated (using methods like Maximum Likelihood Estimation), ARIMA can be used to forecast future stock or asset prices by projecting the relationships between past observations and errors.
- Error and Residuals Handling: The model will try to minimize the residuals or errors in prediction using the moving average terms. Any sudden fluctuations or price spikes (which are difficult to predict) are handled by the error term.
- Limitations: ARIMA assumes linear relationships, which may not always hold true in the stock market. It is based on past data and may not account for external factors like market sentiment, news, or macroeconomic indicators.

Random Forest Regression

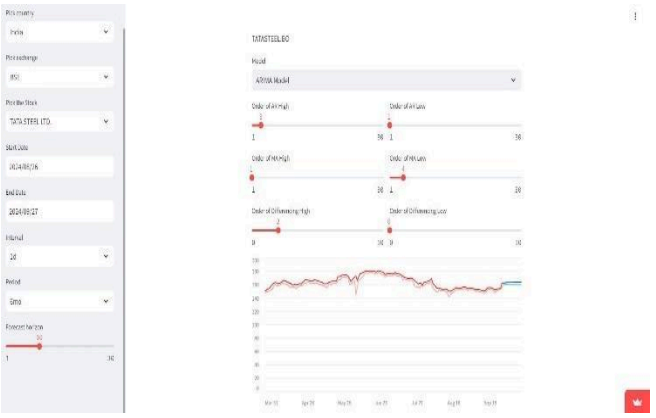
The Random Forest, an ensemble learning technique, combines the predictions of a large number of decision trees to yield more accurate and stable outcomes. It is a supervised learning algorithm that relates most commonly to classification and regression functions. Typically, individual decision trees have high variance; Random Forest reduces this by processing several trees in parallel, cut on different data samples. In case of classification problems, it's a majoritarian voting finale, while in the case of regression, it averages all the outputs of each tree, which is called Aggregation.

Advantages over ARIMA in Forecasting the Stock Market

The construction of random forest models provides an advantage over ARIMA, because the random forest is able to discover very complex and non-linear relationships in stock market data that would be missed by the linear models of ARIMA. ARIMA works satisfactorily for time-series forecasting when trends are stable, but it languishes in challenging times of rapid changes or irregular patterns characteristic of financial markets. On the other hand, Random Forest manages a large number of features, including technical indicators and external factors affecting markets, without reference to stationarity constraints. This enormous flexibility complements the ensemble nature of Random Forest, augmenting predictive accuracy on very large datasets while curbing overfitting and improving the robustness of the respective model in making financial forecasts.

IV. Implementation

The first landing page deals with opening an account that redirects to upstocks website that deals with creating a Demat account for the users. Next there is a stock market trends page that redirects to ticker webpage and shows the stock market trends in real time. Then there are various tabs that deal with various stocks information. The website is hosted on StreamLit cloud service in which our stock prediction model is implemented which contains various AI algorithms that helps to predict the future trends of the stock selected.The ARIMA(Auto Regressive Integrated Moving Average) serves as the main approach used in traditional system forecasting. ARIMA is one of the most powerful statistical approaches for time series forecasting including stock market prediction. ARIMA models use historical data in stock prices, which helps in determining trends.



Our one more important feature is personalized chatbot that basically helps users to buy or sell the stocks. Users just need to enter the details of the stock that they want to invest in and the chatbot will take all the historical data and then give predictions of the stocks and tell the user whether to invest in it by buying or selling the stock.

V. Result

SMAPE (Symmetric Mean Absolute Percentage Error) analysis was conducted in the research to evaluate the accuracy of the different forecasting models used for stock market predictions.

The SMAPE (Symmetric Mean Absolute Percentage Error) formula is:

$$SMAPE = \frac{1}{n}\sum_{t=1}^{n}\frac{|F_t - A_t|}{(|A_t| + |F_t|)/2} \times 100$$

Where:

F_t = Forecasted value at time t

A_t = Actual value at time t

n = Total number of data points

SMAPE Analysis:

- Simple Exponential Smoothing:
  - SMAPE for High: 0.028
  - SMAPE for Low: 0.03
- ARIMA Model:
  - SMAPE for High: 0.018
  - SMAPE for Low: 0.021
- Random Forest
  - SMAPE for High:0.016
  - SMAPE for Low:0.019

Best Performing Model:

- **Random Forest** has the lowest SMAPE values (0.016 for high and 0.019 for low), indicating it provides the most accurate predictions compared to both ARIMA and SES models.

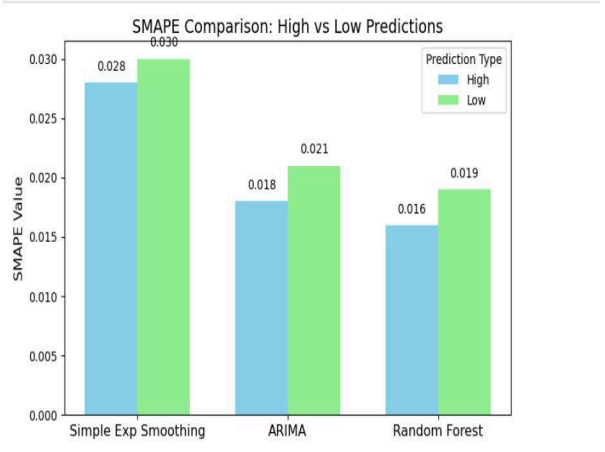
Improvement

Formula for Percentage Improvement:

$$Improvement\ \% = \frac{(Other\ Model's\ SMAPE - ARIMA\ SMAPE)}{Other\ Model's\ SMAPE} \times 100$$

Random Forest has shown a significant improvement over both SES and ARIMA:

- **Compared to SES**: 42.86% improvement for high predictions and 36.67% for low predictions.
- **Compared to ARIMA**: 11.11% improvement for high predictions and 9.52% for low predictions.



ARIMA versus Random Forest shows the contrast in financial forecasting over the time scale. ARIMA suits well for statistical modeling and static data shortages, and fits itself well with expected patterns and seasonality. Its weakness is being thrown off by sudden economic changes and non-linear dependencies. Random Forest employs an ensemble of decision trees, which can learn complex non-linear correlations and thereby improve the modeling of unstable data. At the same time, ARIMA is simple to comprehend and easy to interpret, while Random Forest appears to be the best-performing forecasting model, having achieved greater forecast accuracy with lower SMAPE values, for both high variance and low variance forecasting.

VI. Conclusion

This research aims at developing an AI-based personal finance advisor on stock-markets investing and combining them with cloud computing to optimize performance, scaling capabilities, and real-time decision-making. The system deals with issues of data security, algorithmic bias, and transparency in order to ensure that reliable and individual practical advice is given to the user. The solution combines sophisticated AI models and cloud infrastructure and makes investment guidance increasingly accessible, affordable, and convincing.

The implementation of this AI-based personal finance advisor further marks a major step towards financial freedom for information. Cloud computing provides the means to improve computing efficiency and is capable of giving confined investment tools free and available to all users, thus allowing them to make balanced financial decisions resulting in greater participation in the stock market while enhancing financial literacy.This comparative analysis is with regards to SES, ARIMA, and Random Forest algorithms-analyzing them in terms of their competencies and performance in economic forecasting. Possession of such knowledge is bound to allow future developments of models capable of allowing AI to give the most accurate and personalized investment advice.

Future work will focus on the optimization of the algorithm model to reduce bias and improve the accuracy of financial forecasts. However, new measures should be sought by the investigators to secure privacy and the integrity of the data since trust in Al remains important in the field of finance-based technology. If such challenges continue to be addressed by drawing on insights alighted from comparative research, personal financial advisors will better adapt to an ever-evolving fintech landscape and remain worthier partners to their users in the daunting journey of business investment.

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