

Inclusion of Technology 4.0 in the Financial Decision Making Process

¹ Naman Mishra, ² Manju Dahiya

Abstract

The main aim of this study is to provide a comprehensive analysis of the ease that technology has provided in the decision-making section and the mobility it adds to the financial one. We see that technology has been the steppingstone in the progress of the society and how the various algorithms has eased the decision making process, and the accuracy to which they provide the answers to various questions. The various other technologies and their use cases in the financial sector is also explored and we see their impact in terms of efficiency and load distribution in a workplace. Being able to successfully conclude our research we see that the penetration of technology in every field has been massive and as such its contribution in easing the economics processes is exponential and massive. The positive impact that technology has on the decision-making process by comparing its accuracy with the known parameters, shows how much efficient they prove to be in real time. In this study we used our primary data and used prediction techniques to successfully show the efficiency of these algorithms in the financial sector, the high accuracy of these algorithms increase trustworthiness by successfully predicting the GDP growth rate of the country as well as the stock price prediction of some stocks. The required data is used from the Kaggle database, to support transparency and accountability. This research would help the financial community to accept the support of technology in the crucial decision-making process allowing them to be flexible in real time and make inclusive decisions. The presence of technologies like Cloud computing, AI, blockchain, big data analytics and many more showcase the different use cases in the financial sector and strengthen the trustworthiness of these technologies. The study is significant because it highlights the importance of technology in the field of financial decision making. By showing the different use case of technologies, we show the efficiency that the inclusion of technology would bring into the process and make it more streamlined, the trust factor towards technology is also boosted in the masses which fears giving away monetary decisions to others.

Keywords: Artificial Intelligence, Big Data, Decision Making, Financial Sector, Machine Learning, Cloud Computing

¹Naman Mishra

Department of Economics
School of Arts and Humanities
FS University, Shikohabad, India
mnaman225@gmail.com

²Dr. Manju Dahiya

Associate Professor
Department of Economics
Galgotias University, India
manju11jan@gmail.com

1. Introduction

Modern technological advancements have made their way into each and every aspect of our lives, be it manufacturing, health care, automobiles and whatnot. So, it should not come as a surprise that technology has made its way into the financial sector as well, the prime use which is comprehensible to the common people is the inception of blockchain by the use of cryptocurrency. The name of crypto is now synonymous with the use of currency and these things have also given rise to a new term "Fintech" or Financial Technology which makes use of technology to ease the process of financial corporations to automate and improve their business standards. In this research, we shall focus on the use of the various technologies that can be incorporated into the decision-making process and boost the same, primarily The financial decision-making process includes two different aspects first is about the investment decisions which see to the different investment aspects of long terms and short term, the other aspect is the management decisions to carry out the work of the organization easily.

When we see the current system of financial decision making we see that it is effective in terms of data management, leading to a loss of a majority of the insights, even if the data is managed effectively, the processing of such huge amounts of data has led to many errors arising in the same. The current system although digitalised is not optimised, still much of the work is still done by humans and this leaves a large room for error in the process, Zhao (2022) based their research on the same and found that the current systems deployed in the industry are rudimentary and not intelligent enough thereby are being inefficient. So to make the systems more effective and improve their quality, the different technologies must be integrated into

the same and the research focuses on these technologies and the ways they can be optimised in the workflow. The optimization of the workflow with an increase of technical

inputs, and making smart and well-informed decisions are the aspects which are highlighted throughout the research.

2. Review of Literature

There have been many research regarding this subject in the past where Abad et.al (2020) describes us the various stages of technological development in the financial sector as well as shows the growth of this subject as a research topic, this is imperative to understand the correlation between technology and finance. The advancements in the field of finance and technology with its link to Fintech 3.0 was studied by Padan (2020), leading up the advantages of technology in the financial sector but leaving the discussion open for technology 4.0. The research in the field of banking and the integration of technology was conducted by Broby (2021), commenting on the use of digital payments and online transactions. A similar study was conducted to understand the impact that different technologies, that streamlines the process and increases productivity (Liu, 2020). Studies to gauge about the impact that Fintech would have on the Indian economy and polity have been conducted with much detailed precision (Nishmitha, 2017), but the topic of decision making in the sense of finance is yet untouched, there have been works which pertain to the management of technology in aspect to the decision making sphere as well as the proper usage of algorithms in its assistance have been carried out (Sharma, 2023). There also have been imperative and detailed discussions about the pros and cons of the usage of technology in the organizational stratosphere as well as many approaches have been suggested to incorporate technology successfully in the atmosphere (Baporikar, 2014). A similar study was done which focused on highlighting the use of AI in business and thus provided a model on which Ai could be integrated in business (Mishra, 2021). With the work of review it can be see how AI has changed business values and how it has contributed to either its gain or fall (Enholm et.al, 2022). All these works

are primarily focused on technology in general and there is no proper work which focuses on the financial sector, giving a comprehensive strategy to implement them without disrupting the current system. We see that in the current form financial sector has been impacted by technology but the trustworthiness, the optimization that technology would provide to the decision-making process is yet to be discussed and as such we provide an overview of the proposed system and try to bridge the gap between the requirements and the current present infrastructure this study has been carried out.

3. Research Objectives

The following are the objectives which the paper aims to fulfil:

- To develop a framework, which is effective as well as all-inclusive in terms of the usage of technology in making business decisions.
- To gauge the effectiveness of the algorithms as test their efficacy.
- To promote use of technology in the business decision making process.

4. Research Methodology

The research makes use of primary data to make sense with the help of various predication models as well as forecast the real time values, Other than the primary data, the research is an ensemble of various technologies which are required for the development of the framework and thus is qualitative in nature.

5. Technical Framework

To better understand and utilise the microsecond inputs and shifts in data, it is imperative that proper technology is employed at the right levels and therefore it is used judiciously, to ensure that technology is being integrated at the right level a framework is proposed, which

encompasses the various technologies and provides better result in the decision-making process. On the organisational and fundamental level, the framework proposes the integration of certain technologies to save time, optimise the workflow and increase advantage.

a. Cloud Computing

The framework believes that the use of cloud technology is a must to ensure seamless connectivity and efficiency. On the institutional level, the use of cloud-based servers allows any fluctuation or any information relayed to be made available almost instantly, making way for real-time readings. The first step in optimising the process would be cutting down the various expenses and rooting out the factors of bottlenecking, information relay being the leader in the same. With the use of cloud computing, it has already been proven that cost is cut down to run a business as the hassle of maintaining big servers, and large hardware is dropped and hence the organization can focus on other things. The proposed model makes use of this to incentivise the companies to incorporate more of this technology and thus help them to scale their operations without the need for any more working capital. The enhanced connectivity, which accompanies cloud computing helps the model to understand any fluctuation and pass the information in real-time. The model becomes robust from the security point of view any breach of data and any unauthorised access is blocked, thereby maintaining trust in the decision-making process. After having evaluated the need for quick information, the model understands the importance of cloud computing and thus recommends it as the first step.

b. Big Data

On the individual level, or the level of the company the next step in the framework is the proper utilization and optimization of the data stream. This can help the use of big data analytics, In the financial world even a single individual accounts for terabytes of data in a single year,

hence the proper challenging of data becomes imperative to streamline the process. The big data tools will be deployed in the cloud architecture and will handle all the data in a financial department. In India, while making any financial decision pertaining to any individual like loans, or rents the CIBIL score is checked and referenced, This score is the sum total of all the mortgages, and loans of an individual and builds his financial profile. In the current system, the score is generally changing from partner to partner as they own different information, to bridge the gap and capitalize on the opportunity big data analytics come into play, where the data of all services is present on the cloud framework, allowing for real-time calculations, and relaying of information in seconds. The inclusion of this improves the understanding of data and makes way for cleaner, unbiased data to be fed into the system for predictions.

The two technologies in the proposed framework allow for better processing of data and cleaning of biases, any prediction that shall be made by AI can be trustworthy and ethical only if the training data is clean and well organised. The quick computation and detailed analysis of the data provide more insight into the language of the data and streamline the process allowing the machine learning algorithms to provide better accuracy. These two techniques are also important in imparting enhanced security features in the financial atmosphere. In the most recent times, it is seen that the sector has been prone to many security issues and firewall breaches, hence the deployment of IaaS (Infrastructure as a Service) greatly relieves the institutions of the security burdens and allows for services to account for the numerous security measures. Another layer of security that can be added to the financial institutions and the framework is the integration of smart contracts backed by blockchain technology. The advantages that smart contracts provide are vast and are inclusive of the fact that they are self-verifying in nature easing the

work to be done by the institutions, it is the most secure form of contract as they cannot be tampered with in any kind and increases the trust factor of the financial markets. As of now the contracts based on papers require a lot of maintenance, and monetization while on the other hand, the best part of smart contracts is zero to no maintenance and no cost of implementation. The same concepts that run smart contracts, build the blockchain based unbreakable security features. With all the base foundations defined and the data handled efficiently, the next step in the framework is the use of algorithms to classify and categorise the data to make proper predictions. The next part of the framework is the application of the AI and ML models to achieve better data prediction and analysis.

c. Artificial Intelligence and Machine learning

The next step of the proposed framework is the implementation of AI to make sense of the data and thereby provide us with inputs to make decisions. AI and its implementation are not just limited to making decisions but also allow for the automation of certain repetitive tasks and reducing the workload of humans. With the effects of automation, the need for manual scavenging of assets and investments has become redundant, The process of risk assessment and financial profiling is also done with the help of these algorithms. In the framework, AI is proposed to do a time series analysis of stock prices as well as the GDP of the country to provide accurate results and predict the future of the same. The advantage of such a model is that it allows big corporations to play a safe bet in terms of investment when stocks are considered while on the other hand, the position of the market can easily be assessed by the GDP and therefore direct a path to the company to capitalise their investments.

The model that is being used to make predictions based on time and the future used in this model is the ARIMA (AutoRegressive Integrated Moving Average) and bagging

regressor. ARIMA is a simple yet, progressive model that is readily used in forecasting data in terms of time series, This model is the choice of this framework since it is a combination of three different concepts namely autoregression, integration and moving average. The advantage of autoregression is that it uses the predictions made on previous data to make new predictions and the moving average allows one to easily predict a time series as it makes it static by use of average change. This model therefore is the perfect choice for making any time series prediction and comes in handy in the stock price prediction, mathematically This model is denoted as $ARIMA(p,d,q)$, where p = lag order or the number of lag observations, d = degree of differencing, and q = order of moving average. In the model of the framework $ARIMA(5,1,0)$ is used. The other algorithm that has been used in the framework to make a prediction on the GDP is the bagging ensemble model which is basically an aggregation of many decision trees. It works by using base regressors on the dataset and then making an aggregation of their predictions to make a final prediction, it is more effective in this problem as it allows for different decision trees to fit on the perfect data and then make predictions on a larger scale.



Figure 1: The different steps in the proposed framework

In the above figure a flowchart of the proposed framework is presented which shows that how different parts of the framework refine and streamline the process and thus helps in optimising the decision-making process, the framework gives a comprehensive oversight on the operations involved in financial decision making and how it can be improved.

6. Data

To test the efficiency of the algorithms and show their use case in the financial decision-making process, two data sets were used one to perform the time series analysis on the Stock market data set and predict the price of Tesla stock. On the other hand, a data set was used to predict the average rate of Indian GDP and predict the same in the future. The data sets were procured from Kaggle namely, "Huge Stock Market Dataset" (Marjanovic, 2017), which provides the daily price, volume of the US based stock prices and "India GDP 1960-2022" (Mukati, 2022), dataset which provides the information about the growth rate, per capita GDP of the Indian Economy. Both these data sets were tested on the given models and the results were carefully studied to show the efficiency of these algorithms in the decision-making process.

7. Results

The (Marjanovic, 2017) was fed to the ARIMA model to evaluate the time series, but before that data is analysed and cleaned via the pre-processing and some exploratory graphs are generated. Figure 2 shows the fluctuation of the close price of the Tesla stock over time, on the other hand Figure 3 shows how much cumulative return the stock has given over time elapsed.

Since it is an expansive dataset of about 1800 values, the data set is split into two parts of training and test, to train the data on the first and then gauge the performance on the second part, figure 4 shows the split between the training data and the testing data.

After all this was done, the data was fed to the model and thus it was tested across the test data set that has been split, to gauge the efficiency of the predictions the Mean Squared Error parameter was used and the value was found to be 40.550 and simultaneously figure 5 was plotted showing the variations and the difference between the predicted prices and the actual one.

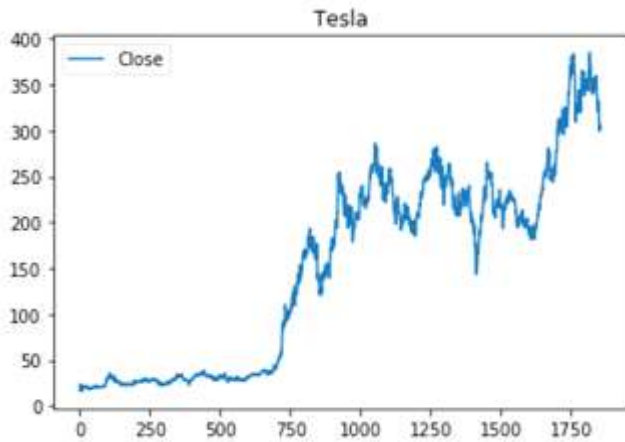


Figure 2: Tesla Close value over time



Figure 5: Tesla Stock price prediction

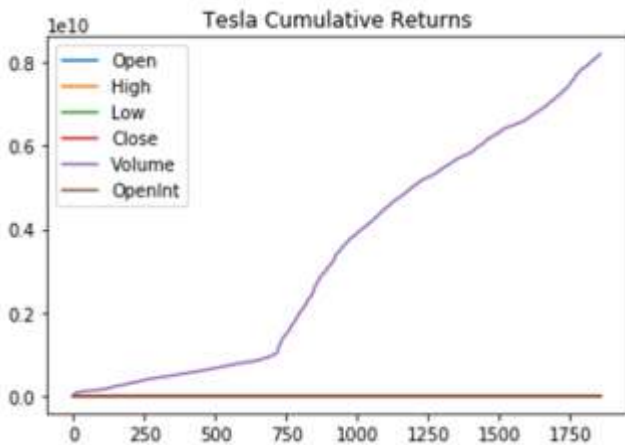


Figure 3: Tesla Cumulative Returns over time



Figure 4: Split between Train data and Test data

The (Mukati, 2022) was fed to the bagging regressor to predict the GDP over time and Root mean squared error parameter was used to check for its efficiency. Being an expansive data set, univariate analysis was performed on the different fields showing change of the said parameters over time.

After this the data was cleaned and the outliers were removed by the process of winsorizing, and hence it was fed to the regressor. The model was gauged by running the RMSE parameter which calculated the Train dataset RMSE to be 2.39 and the Test dataset RSME to be 2.19.

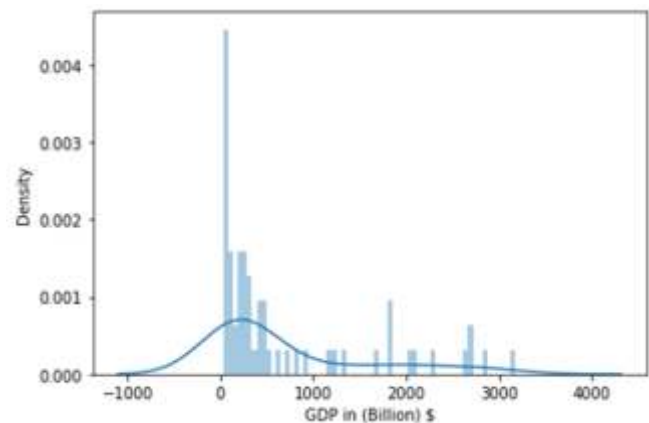


Figure 6: GDP Distribution over years

8. Conclusion

We see that technology has come a long way from taking away the manual labour of people to even taking away their mental labour. In the field of finance, the integration of technology has been a reality since the computer age but now it requires the new technologies to get the required boost. Throughout the study, the different use cases of the implementation of technology are highlighted, and a framework is proposed for streamlining and generalizing the process. The efficiency of the algorithms is tested based on the standard parameters to show their success, while the graph shows the accuracy to the human eye to instil confidence in the decision made by these algorithms. The two different use cases of the predictions made also

provide a practical insight as to how these things would be implemented and how these technologies would help the industry to be more optimised and time efficient. The paper uniquely shows how various technologies can be included in a business to make the decision making process more streamlined as well as presents a use case in terms of predictions, which shows where and how things could be done. The only limitation of the framework is the extensive need for reformation in a traditional business environment as well as the reliance on a continuous flow of data to initiate the process. The authors call on future research to further test the framework as well as develop better decision-making algorithms to make the process relatively easier.

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