

Application of Artificial Intelligence in Forecasting: A Systematic Review

Albert Annor Antwi
Zhejiang University of Science
and Technology
School of Information and
Electrical Engineering
Liu-He-Lu, Zhejiang - China

Ayman A. M. Al-Dherasi
Zhejiang University of Science
and Technology
School of Information and
Electrical Engineering
Liu-He-Lu, Zhejiang - China

Yang Chunting
Zhejiang University of Science
and Technology
Liu-He-Lu, Zhejiang - China

ABSTRACT

Purpose:- The aim of this reach is to identify how Artificial Intelligence (AI) could be used in enhancing forecasting to achieve more accurate outcomes. The research also explores the influence that forecasting has on global economy and the reasons why it needs to be accurate. Also, the research explains various pitfalls identified in forecasting. **Method:-** This research implements two research approaches which are review of literature and formulation of hypotheses. Seven hypotheses are created. **Findings:-** AI, when integrated with other technologies such as Machine Learning (ML) and when provided with the right computer power, yields much more accurate results than many other forecasting methods. The technology is costly, however, and it is prone to cyber-attacks. **Conclusion:-** The future of business is highly reliant on forecasting, which directly impacts the global economy. But, not every business will have the power to own the forecasting technology due to the cost, and business will need to increase security to protect the forecasting systems.

Keywords

Artificial Intelligence, Forecasting, Business, Finance, Market, Machine Learning

1. INTRODUCTION

Artificial Intelligence (AI) is one of the technologies that has been and continues to be outstandingly useful and efficient in automatic computerized systems to become more and more customized as per human needs. AI is the main technology that is implemented with the aim of making machines intelligent and be able to mimic humans in actions as well as in doing various things. Typically, computers systems have greater capabilities of gathering and analyzing data; far more than humans could. Combining Artificial Intelligence with other technologies such as machine learning, which has algorithms that learn patterns and are able to repeat actions represented by the patterns. In forecasting, for instance, AI and machine learning analyze the patterns in the market and establish a systematic trend in it, which could be applicable even in the future. [1] views forecasting as a science since it is characterized by scientific goals, and it involves establishing sets of data that are analyzable with outcomes being either optimistic or pessimistic.

Forecasting is essential in investment, which places AI at high demand. Already, there has been achieved numerous benefits of forecasting such as the case of weather and climate, which assists agricultural professionals to schedule and plan their agricultural activities, since agriculture is heavily influenced by climate [2].

Recently, business planning is heavily reliant on forecasting. A case study carried out by [3] illustrates that forecasting is becoming an integrated part of business along with planning and process management. [3] therefore presents forecasting to have equal value with planning and process management to business. Without these three elements of business being done right, chances of the business surviving are usually minimal. But, when they are done right, the possibility of business growth remains elevated. Apparently, forecasting helps in future prediction of the market trends, it also helps a business evaluate its past and therefore be able to have a clearer focus on the future; therefore, companies are able to plan better, utilize resources more efficiently, manage inventory, remain competitive, keep the business, and all parties involved updated of the progress and trends that the business may take, among other essential benefits [4]. The only major drawback about forecasting is that if done wrong, it can be misleading. But, a misleading forecast could have devastating effects.

1.1 Research Questions:

- i. How could AI help businesses achieve precise forecasts on market trends?
- ii. How would AI-powered forecasting affect business around the world and the future economy?

2. LITERATURE REVIEW

There are various works that illustrate how various researchers have explored the application of AI in forecasting in various scenarios and different situations. There are a variety of areas where regression is applicable which may include supply chain, financial analyzing, gaming prediction, weather forecast, among others. This literate comprehensively analyzes these areas and considerably looks into how AI aids this process.

2.1 Electricity Consumption and Forecast

One of the areas of application of forecast is in electricity consumption among electrical devices. According to research presented by [5], an electrical energy consumption forecasting method that implements the conventional AI could provide precise results than other methods that implement other formulas. AI, however, does not work alone. It is implemented along other algorithms such as Machine

Learning (ML), Deep Learning (DL), and others. Forecasting technologies also help in providing essential and outstanding results. Retail is one area that essentially needs forecasting. In an article published on Forbes by [6], demand forecast helps 53 percent of retail startups to become successful. AI, according to this work, is found to reduce forecast error from 32 percent to 0 percent, making it the most accurate and

therefore the most effective forecasting method. This research provides a number of ways through which forecasting works, to the better.

2.2 Supply Chain and Retail (Demand and Supply) Forecast

AI brings into forecasting the capability of examining almost an infinite number of factors that affect a certain business simultaneously [6]. This is one outstanding capability that is efficiently and effectively applicable in retail, supply chain, and any other part or aspect of a business. But, to achieve this, different approaches that suit different environments have to be employed. [7] puts forecasting in different categories which are exploratory or normative, Exploratory techniques include trend extrapolation, technology substitution, s-curve, and cycles. This set of techniques is statistical and therefore can be integrated with AI to maximize the benefits or rather to increase the accuracy of forecast outcomes, especially trend exploration [7]. In another research conducted by [8], the supply chain is highly impacted by use of AI in forecasting. This research puts emphasis on the research presented by [6] which illustrates that unlike other forecasting technologies, AI is capable of providing forecast that is 100 percent accurate or with 0 percent error rate.

One important thing about accurate demand forecast is that producers and suppliers produce and supply the right amount of goods respectively, which automatically leads to reduced inventory cost, which in turn improves capital performance, which is a solution to capital constraint [6][8] More benefits of the accurate forecast include creation of stable competition. The major benefits of stable competition include the creation of sustainable competitive advantage, particularly for functional products. But, to get ultimately accurate results, it is essential to combine AI with ML [8]. This is because ML assists AI in becoming a better learner and therefore helps it in coming up with far much better forecast. [8] compares the present-day approaches of forecasting which are AI-enabled to the old ones and according to the analysis, there is a very large gap between the technologies, particularly on the aspect of accuracy. AI and ML have so far helped in achieving the most outstanding results as far as forecasting in the supply chain is concerned.

2.3 Forecast Aided By ANNs Algorithms

AI AI implements algorithms used in artificial neural networks (ANNs), which have had a great impact on forecasting. ANNs provide an architecture that allows computers to function like brain neuron. But, what makes them more advanced is that they are fed with much more data than humans can hold. They work on the data and analyzes it to come up with efficient and effective results when it comes to forecasting [9]. The architecture is fed with data which it analyzes and gives feedback as the results of the forecast. Some of the algorithms implemented include the linear regression and non-linear regression as indicated in the diagrams below.

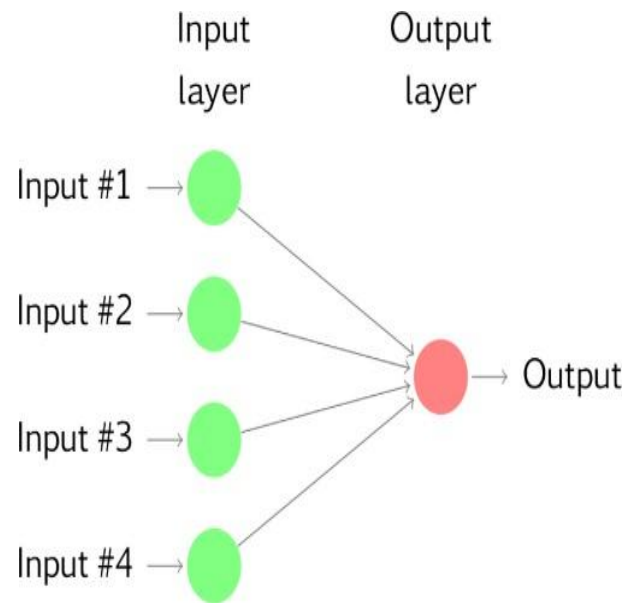


Fig 1: Neural Networks in Linear Regression [9]

Under the linear regression approach illustrated in Fig 1 above, a model is slowly trained with inputs and directed to give a certain output. But, this model is later advanced to become more efficient and effective, which indicates that the system is more outstanding and more efficiently delivering the best of needed output in analysis and forecasting. Training is the key concept and the key requirement in this work.

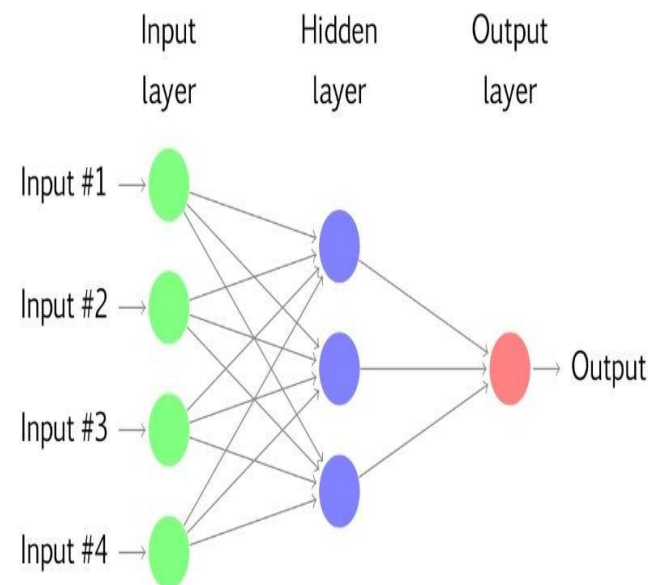


Fig 2: Neural Networks in Non-Linear Regression [9].

The above illustration shows a multi-layer feed- forward network on which each node receives input from a previous layer. This model is slightly more complex but has more outstanding results [9]. Another advantage that makes ANNs suitable in forecasting is that they facilitate auto-regression. This means that series of data that is lagged of values and time series can be input and implemented efficiently.

2.4 Financial Forecasting

For AI to comprehensively achieve financial forecasting, it has to heavily rely on ML algorithms. Here a slight gap is identified, but this does not imply that the networks are not

usable in management and analysis of content. However, already AI provides very important aspects of forecasting which includes data clustering, interval determination, weighing intervals or clusters, limiting calculations, and other activities that are essential in financial analysis and forecasting [10]. In fact, when the algorithms get combined with those of ML, ANNS, and IoT components be provided, it will be possible to create AI-based systems that can offer better and logically accurate financial analysis compared to other algorithms. However, the more algorithms and resources such systems will need, the costlier they will be, this means that the major focus should not ignore the cost while eyes the benefits.

Implementing AI in financial forecasting does not guarantee efficient and outstanding results whatsoever. A firm needs to choose the right path, and this requires avoiding any challenges that may come its way in forecasting and lead to results that may be deceiving. AI is digitalized and does what it is supposed to do in an automated way. But, human control and effort are required. It has to be fed with efficient and outstanding data. The other requirement is for it to be efficiently understood by the individual doing the analysis. Apparently, AI applies to data management is a rather essential and efficient way, which could any market area [13]. This implies that the forecast can be done on a small market segment or on a wide market range. So, any business can use AI forecasting for precisely outstanding results.

2.5 Uber Case

In a case presented by [11] on Uber Engineering, forecasting has been very important for Uber as it helps the company in financial decision making and planning for its future investments. Already, Uber operates in above 600 cities worldwide, and its recent venture of Uber Eats most definitely requires forecasting technology to help the company know which is the best move for it. The company has to rely on forecasting for efficient and effective decision-making for the sake of tackling any challenges that may come their way. In this case, Uber implemented an internal financial system that would provide the company with real-time financial forecast. The financial forecasting system implemented artificial intelligence algorithms that worked on the model shown below for financial planning.

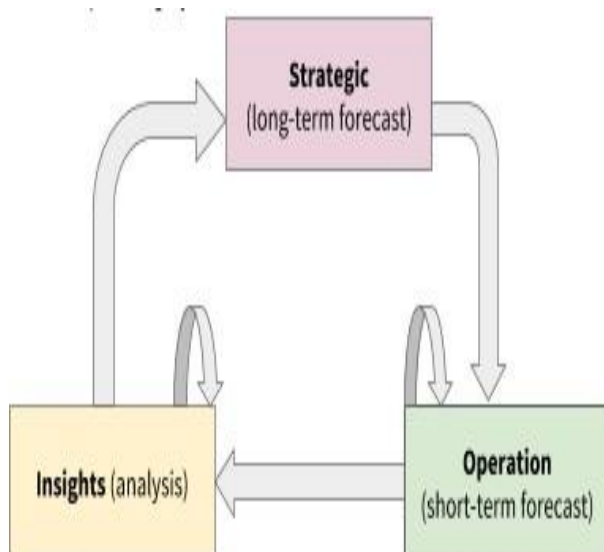


Fig 3: Uber's financial planning cycle that implements AI [11].

The model above collects information regarding transactions, which illustrates the application of Big Data in this case. Analysis of the big data using AI and ML algorithms provide insights are applicable in strategic (long-term) and operation (short term) forecasting. Strategic planning assists in determining the budget that a company could allocate a given venture depending on the impact it could have, particularly in facilitating fulfilment of goals and achievement of objectives. It also helps in creating a time frame for the financial cycle. The case of Uber also gives more insights into how forecasting helps in enhancing operations and insights. Operations basically involve following the strategic planning put in place. This implies that the set target has to be achieved. A relatively short time frame is used in operations planning, which lasts little lesser time and has repeated cycles on spending on budgets. On insights, the business performance is evaluated with reevaluations and adjustments on the budget target which are necessary in making recommendations for improving financial forecasting.

There are various key components of AI solutions which require to be efficiently and effectively implemented. They include the fact that AI is implemented as an independent domain, it is a data science, and AI is digital [12]. Therefore, AI algorithms critically identify and maps the factors that materials bring about in bearing on revenue. AI is needed for enhancement of core market drivers which include sales projections, marketing and promotions, price variability, incentive programs, and competitor activities [13].

3. METHODOLOGY

This research majors on review of literate and analysis of cases where AI has been implemented in forecasting. Using the keywords applied in this research, was obtained from online databases such as Google Scholar and other digital libraries as well as websites. This research capitalized on using peer-reviewed and published works such as journal articles and books. Also, magazines and articles from other reputable websites are used in this research. This research combines a review of literature to formulation of hypothesis. The literature is applicable in giving the results or the feedback to the formulated hypothesis regarding usability test. The hypotheses are interdependent, where one case influences the other. Below are various hypotheses that this research seeks to prove concerning the research questions that this study seeks to answer.

H1: Forecasting has a deep impact on business

Citing from the different literature sources that have been reviewed, forecasting has an impact on business. But, it is essential to explore more and understand how deep the impact of forecasting is to businesses. According to [15], forecasting helps business to foresee the possible risks that may bring them down and therefore be able to plan on how to evade or minimize them. Forecasting also helps business be able to take positive action and therefore be in a position to thrive well. Also, forecasting helps in managing sales and adjusting the sales strategies. It is also a means for fulfilling due diligence requirements for potential lenders and investors as well as other personnel who may want to acquaint themselves with a business. Also, as indicated earlier in the review of literature, forecasting enables cash flow management

— balanced spending and improvement of accounts.

Farming is business as well. And forecasting has an impact in farming from two dimensions—the business side and the weather side. The weather forecast has become a tradition in the modern lifestyle, and it is also associated with a lot of

benefits. Weather forecasting allows farmers to be able to plan on farm management with the determination of maximizing yields. The yields are very much influenced by weather, which requires them to plant the best crops depending on the weather forecast. This translates to maximizing their yields, which leads to more outstanding results. Another research by [17] illustrates that financial forecasting is a strong influencer of trends in business and needs to be efficiently managed, which means forecasting has deep impact on business. This, in concluding this hypothesis, it is true that forecasting has deep impact on business.

H2: Forecasting could help in improving the stock exchange. One thing that stock traders struggle to achieve to know when to buy and when to sell a stock for their maximization of profit. Forecasting should not be considered as a requirement or a technology that would enhance forecasting. Instead, it should be considered a part of the stock market [18]. The stock market requires forecasting for economic analysis. AI, in this case, is required in identifying economic indicators and in giving hint on overall trends in stock market. The Federal Reserve, for instance, needs to forecast trade to help it keep the financial system flowing efficiently. Technical analysis for indexing the analysis of stock price requires periodic timestamps that differ in intervals of 5-10 days, 10-20 days, and long-term periods of 200 days [18]. Investors need to know the future value of a given product, which indicates that they have to ensure that at least they have some knowledge on how the market may turn out to be in the future. One needs to wait for the market to drop so that they can buy and wait for it to rise so that they can sell. Some investors do not want to wait for so long until the stock rises, which requires them to have a predictable schedule that would allow them to improve their exchange capabilities [19]. Therefore, it is conclusive that forecasting has a deep impact on forecasting, which is a financial entity.

H3: Forecasting using AI is more accurate than other forecasting methods.

This hypothesis is fully supported by various reviewed works in this paper's literature. Forecasting systems that are supported by AI have proven to be more accurate than ones that do not implement AI [6][8]. [20] sees AI as the future of forecasting, which is mostly based on how accurate the outcomes of this technology is. Also, its applicability in weather forecast as illustrated in the literature proves its reliability and acceptance [2][17][20]. The aspect of AI being digital makes it possible to integrate with other technologies easily and to reinforce each other to come up with efficient and outstanding forecasts. But, [21] presents a possible obstacle that holds AI back from being implemented as one outstanding and iconic prediction method. Technically, AI has to work on computers. The AI algorithms themselves are human-made, which implies that everything about AI and computation can be altered especially when power and influence come in. So, on the one hand, forecasting could yield the most accurate results on the other hand, there is a high risk of data manipulation which is faced by AI systems.

H4: Creating AI-based forecasting methods is costly.

In proving this hypothesis, the basic question to ask is, "how much does AI cost to implement?" According to [22], the cost of AI depends on complexity, but one thing that is for sure is that it is a must to implement or run high computation power. Also, the cost of AI is dependent on the step of implementation and the expertise needed in implementing it. For instance, in forecasting, high computation power is

needed, and it may need to be integrated with other technologies such as Big Data analytics, and ML, which adds to the cost [23]. Therefore, it is justifiable that AI is costly to implement in forecasting. However, [24] argues that AI is efficiently beneficial or rather the output that is yielded is far much greater than the incurred cost. So, investing in AI-based forecasting has greater returns.

H5: AI-based forecasting approach has more benefits compared to cost. Indeed, as argued by [24], AI-based prediction has numerous benefits to businesses, which makes it worth implementing. Price forecasting gives businesses insights on the best time to buy and the best time to sell. It also provides a descriptive analysis of the market. As explained by [25], planning is one essential requirement for any business. AI-based forecasting also provides descriptive analytics of a business in a statistical manner, which helps in answering the question "what happened?" Answering this question could help a business avoid risks and mitigate any possible dangers in the future. One better way of ensuring that AI is efficiently and effectively implemented is by running a revenue analysis and comparing the financial trends that an organization has had with AI and without AI. Since AI is applicable in numerous areas, it becomes efficient and effective application in business analysis.

H6: If AI-based algorithms have such deep positive impact on the global economy.

Statistical analysis allows businesses to minimize losses and maximize profits, which implies that it leads to growth of the global economy. Moreover, AI is applicable in far more reaching ventures. It is one technology foreseen to be on a high demand shortly, which implies that AI and forecasting as independent entities have impact on the global economy. Also, when they are brought together, they are found to have great impact on the global economy [26][27].

H7: AI-based forecasting is subject to cyberattacks

Technically, cybercrime is advancing fast, even more than human technology is growing. [28] illustrates the possibility of cybercriminals manipulating AI algorithms to give false predictions. Already, the world has witnessed many incidences of cybercrime, which leaves no doubt that cybercriminals are capable of manipulating the AI-based systems to their interests. In fact, [28] adds that implementation of AI in forecasting adds to the existing threats and also introduces new threats and advances threat characters. Also, AI-based forecasting is an emerging technology, and such technologies are being termed as prone to cyberthreats irrespective of how beneficial they are [29]. So, it is justifiable that AI-powered forecasting is prone to manipulation through cybercrime, which proves this hypothesis to be true.

4. RESULTS

All the tested hypotheses in this research are found to have a positive outcome, as summarized in the table below:

The hypotheses tested evaluate both the good side and the bad side of AI as used in forecasting. H1, H2, H3, H5, and H6 explore the positive side of AI-based forecasting while H4 and H7 look at a gap, where AI-based forecasting may bring about false results out of manipulation and where companies may struggle to keep the technology.

H#	Hypothesis	Proven?
H1	Forecasting has a deep impact on business.	Yes
H2	Forecasting could help in improving the stock exchange.	Yes
H3	Forecasting using AI is more accurate than other forecasting methods.	Yes
H4	Creating AI-based forecasting methods is costly.	Yes
H5	AI-based forecasting approach has more benefits compared to cost.	Yes
H6	If AI-based algorithms have such deep positive impact on the global economy.	Yes
H7	AI-based forecasting is subject to cyberattacks.	Yes

4.1 Gaps/Trade-Offs/Pit-Falls

According to the analysis of the hypothesis identified above there are two major areas that pose difficulties of implementing AI-powered forecasting system. The aspect of high implementation cost results in difficulties in affording the technology, particularly for small businesses. Bigger businesses can, therefore, use this technology in earning themselves an advantage over other technologies. Moreover, the implementers of this technology should consider it as a loophole for security incidences or a channel that cyber-attackers can use to manipulate or sabotage, or alter the information belonging to a given organization.

5. DISCUSSION

Every business wants to prosper and flourish, which is the reason why innovation is always used by many businesses with the aim of building themselves up. Forecasting, for so long has been a considerably essential element for allowing businesses to achieve their objectives. Financial analysis is one very crucial part of business, and it would be technically crucial to use it in forecasting in an essential way. Stock marketers could use forecasting to identify the best time to buy or sell which the better part of it illustrates benefits. In answering the research questions, it is identified that a business can benefit greatly from forecasting and that AI provides more precision in forecasting compared to other technologies. Forecasting also results in improved business planning. From a global perspective, accurate forecasting allows business to effectively and accurately carry out improved planning. So, every business needs efficient and effective forecasting capabilities to allow it to run effectively and efficiently. But, wrong forecasting can bring down a business. Collectively, all these elements could have deep impact on businesses, which in turn have deep impact on the economy for the sake of the future of the global economy. Success in business results in success in the ways of doing things efficiently and effectively. But, businesses and technologists must find cheaper alternatives when it comes to achieving efficient and effective AI-powered forecasting, citing from the information that forecasting is of great importance and every business needs it, but not all businesses can afford it. Efficiency and effectiveness are still needed by the cost ought to be reduced.

6. CONCLUSION

In concluding, this research reveals a variety of aspects that affect forecasting. One of them is that forecasting deeply impacts business. One essential element needed in forecasting is accuracy. Accurate forecast results to better business planning, better financial analysis into the future, ability to reduce or avoid risks, and it also enables businesses to flourish well. Also, forecasting has great influence on stock

exchange, where the buyers and sellers would use forecasts to maximize their sales. With these important inputs of forecasting to the world of finances and business, there is need to make it as accurate as possible. Accurate forecasting could be improved through powering forecasting with AI. However, AI would work best if the standard computation power is provided and when supporting technologies such as ML, Big Data analytics, and others are used. Two major shortcomings are experienced, however. First, these technologies are costly, and not all businesses can afford them, and secondly, cybercrime threatens AI-powered forecasting since hackers can manipulate the technology, which could automatically result to false and misleading forecast outcomes.

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