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SPECIALIZATION Computer Science, English

DIPLOMA THESIS

Sentiment and Credibility-Adjusted Stock Price Prediction

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2025

ABSTRACT

In the last years, there was a significant change in people's perspective over stock markets. Many decades ago, the majority of people were skeptical about investing their money and stock markets were usually seen as being accessible only for the richest. However, the number of investors has grown a lot, and today, the percentage of people who invest globally is in range 15% - 20%, according to statistics. Despite this growth, there is room for improvement, especially among younger generations who, unfortunately, don't have the opportunity to learn the basics of economics. Many believe that a large amount of money is needed to start investing, it is too risky or just expect to see results in a very short amount of time.

Nowadays, lots of tools are providing assistance for investment-related activities like stock prediction and financial news sentiment analysis. Through this app, I want to provide a risk-free environment where users can learn and become familiar with these markets without losing their own money. They will also get a long-term overview on the changes of prices based on reliable news sentiment analysis using text classification and machine learning for time series forecasting.

The main feature of the app is the prediction of prices for some stocks within a 12-month span. Time series forecasting for the prices will be performed using auto regressive integrated moving average (ARIMA) model and all the available historical data for each specific stock. The predicted prices will then be adjusted based on macroeconomic and technical indicators, as well as the reliability and sentiment of related news. Additionally, the duration of the news' impact on the prices (short-term or long-term) will be taken into consideration when adjusting price predictions. If some news event has a long-term sentiment impact, the adjustment will extend over several months and if the sentiment impact is short-term, the adjustment will only apply for a month or two. The impact of the sentiment over the prices will be weighted using a model which outputs the credibility percentage for some news article.

All of these models will be integrated into a mobile app that has educational purpose in the finance field and it also provides users with an overview of the future prices for various stocks. In addition to this section, learning and quiz sections will be included, for allowing users to earn rewards in the form of virtual money, which can be used in a demo investing platform to build their own portfolios. These features create together a well organized step-by-step plan that allows users to learn financial basics from scratch, getting hands-on experience in a safe environment with real listed stock prices and use AI-powered tools to help them make the best choices.

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Chapter 1

Introduction

1.1 Stock Markets and Technology in the Context of Financial Literacy

Stock markets are an important factor in the global economy, they drive economic growth and are often seen as an indicator of the economic situation in their specific region. Through stock markets, an individual can invest almost any amount of money. If they don't have enough funds to purchase a specific stock, they can use alternatives such as mutual funds or exchange-traded funds. This creates great opportunities for both businesses and investors to grow together and help each other indirectly.

Unfortunately, there are large categories of people who are financially illiterate. Annamaria Lusardi and Jialu L. Streeter approached this subject in their study in 2023 to get evidence from US[1] by creating a survey that included basic financial questions together with a question which asked the respondents to rate their self-assessed financial literacy. According to the results, despite the low actual level of financial literacy, most respondents gave themselves relatively high ratings. The statistics gained in the above study shows data about US only, which is considered a highly developed country with highly educated people, especially comparing to other regions of the world. This means that financial literacy is significantly lower among the majority of people in many other countries, which represents a sad truth and it implies that these people shouldn't start learning investing and stock markets' basics until they master the basics of financial domain.

Luckily, there are many solutions to help these people and technology is one of them. Technology plays a crucial role and contributed to the development of the financial sector over the years. If back in the days investors needed to go to physical exchange places and get a handwritten/printed certificate, talk to their brokers, and rely on newspapers for financial information, today, on the other hand, everything

is done using digital platforms. Technology makes easier the information gathering and learning process too, since users can search any information on search engines really quick. This also means that the learning curve for beginners in this domain or for individuals desiring to acquire knowledge is much smoother compared to previous decades. However, there is still a large number of people who seem to fear getting started due to insecurities, lack of confidence, or simply limited financial education. While technology has already helped this sector evolve, there is still room for improvement, especially when it comes to AI-powered solutions. According to [2], technology such as artificial intelligence may change the way investors look at business decisions, risk, and credit analysis. AI might represent a learning tool for people who want to improve their knowledge about economy and stock markets. Large Language Models like Chat GPT already help in various fields. Of course, the information must also be verified in trusted sources, but the learning process is clearly faster.

1.2 Problem Definition and Motivation

Whether new in financial field or just looking to have a fresh start and a transition from theory to practice, many beginners still face challenges. Despite spending 2 or 3 months reading economy books, articles and acquiring knowledge from various sources, the major difficulty often stands in applying that knowledge to actual investment, which means getting actually started in a practical manner. The idea of putting real money into an account and have the fear of losing a part or all of it can be really discouraging. This is completely understandable, especially due to the lack of practical experience, which can only be gained by learning the hard way through real-world involvement. Traditional educational resources may not offer practical learning experiences, leaving novice investors unprepared to make good decisions in the future.

One of the most common ways investors stay informed about companies and the stock market is through news. Financial news articles, reports, and market updates provide important insights that influence investment decisions. Whether it's an earnings report, a major company announcement, or economic trends, investors often rely on news sources to understand the current state of the market and make informed choices. However, the big volume of information available can be overwhelming, especially for beginners who may struggle to differentiate between truly relevant updates and irrelevant information.

Beyond just reading the news, understanding the sentiment behind it plays an important role in interpreting market movements. News can be positive, negative or neutral and investor reactions often depend on how a piece of information is

perceived rather than just the facts. For instance, a company announcing a drop in revenue may seem negative, but if the report includes strong future projections, the market might react in a positive manner. Sentiment analysis helps by determining whether the overall trend of financial news is optimistic or pessimistic, allowing for a deeper understanding of how markets might react.

Beyond the sentiment expressed in individual news articles, the overall sentiment of the masses (market sentiment) has a significant impact on stock prices. Financial markets are highly influenced by investor psychology, where optimism or fear can drive prices up or down, sometimes regardless of a company's actual financial performance. When investors collectively believe that the market is strong, they are more likely to buy stocks, pushing prices higher. On the other hand, fear can lead to panic and overselling, even in situations where the fundamentals of companies remain stable. This phenomenon is often amplified by social media, financial influencers and large institutional investors, who can shape public opinion and cause dramatic price changes. By incorporating sentiment analysis at a broader level, we can capture these trends and better predict how public opinion might influence stock prices in the short and long term.

Another key factor is the credibility of news sources and the presence of misinformation. Not all financial news are accurate, and some sources may exaggerate or spread misleading information, intentionally or unintentionally. There were situations when misinformation was spread quickly specifically for making investors panic and sell for dropping the prices and give the opportunity to others to buy at low prices (also known as market manipulation). Unfortunately, this can happen even if it is illegal because it is hard to prove the intent, but this factor doesn't depend on us and we need to be careful at all our sources of information. Investors acting on false or biased reports risk making poor financial decisions, which could lead to unpredictable losses. By integrating credibility analysis, we can decrease the significance of the unreliable sources and ensure that stock price predictions are based on credible and verified information, even from various sources. This is especially important in today's digital world, where social media and online platforms can quickly spread rumors that may not be backed by actual data.

In addition to news and sentiment, macroeconomic indicators provide essential context for investment decisions and factors such as interest rates, inflation, unemployment rates can impact stock prices significantly. On the other hand, strong economic indicators such as low unemployment can create a favorable market environment. Ignoring these economic factors can result in an incomplete understanding of market conditions and lead to suboptimal investment strategies.

Given the importance of these factors, integrating news sentiment analysis, credibility assessment and macroeconomic indicators into stock price prediction

models provides a more complete and realistic approach to market forecasting. By combining these features, investors, especially beginners, can make better informed decisions, reducing uncertainty and improving their confidence in navigating the financial markets.

1.3 Objectives

This app addresses the gap, combining more features. The main feature of the app is predicting stock prices using time series forecasting techniques for next 12 months. News sentiment and credibility analysis are giving scores as output and they are weighted together to increase or decrease the impact of the sentiment depending the credibility of the news article. Longevity sentiment is also considered for deciding if the prices are affected on short-term (1 month) or long-term (more months). The prices resulted from the time series forecasting model are then adjusted based on news sentiment, credibility and longevity analysis for offering the users an overview for the prices of some stocks on long term and finally macroeconomic and technical indicators are used to adjust the prices. The impact of these adjustments over time gets decreased.

The app also includes educational modules with learning materials, quizzes with rewards for motivating the users to learn and follow the steps, a simulated trading platform with virtual amount of money that can be pumped up only by solving quizzes. The path that a user should follow is reading the recommended learning materials, solve many quizzes and then go to the demo investment platform to use the money gained. Even if the user already starts with a virtual amount, he needs to go through the other modules step-by-step and be able to solve quizzes for getting more money, otherwise one will not be able to get his portfolio bigger due to the lack of funds and will get stuck until solves more quizzes. They could also use the main feature, the AI tool for prices prediction for being able to take easier decisions. This prepares the users for the moment when they will enter the stock market with real money and will get exposed to the real risk of losing the initial value of their stocks. With the experience gained by using this app for a period of time before getting started into the real market, they should be able to take more responsible and information-backed decisions, have a better general overview of the stock market situation and be more confident.

1.4 Original Contributions

Time series forecasting models such as statistical models like ARIMA (Auto Regressive Integrated Moving Average) have been used for a long time, whereas recently, deep learning-based models like LSTM (Long Short-Term Memory) have gained popularity particularly with the rise of AI in the past 2 decades. Text classification models have also emerged, largely due to the recent remarkable progress in large language models (LLMs). LLMs were propelled by the introduction of self-attention layers and transformers, taking the natural language processing (NLP) tasks at another level. These innovations increased the precision of AI tasks for performing sentiment analysis, fake news detection and other NLP tasks.

Natural language processing models are widely used in finance to, assisting with tasks such as sentiment analysis of financial news, detection of misleading information and automation of the decicion-making processes. However, most stock price prediction models focus either on time series forecasting or sentiment-based adjustments without integrating multiple signals to adjust predictions.

This work introduces a hybrid stock price prediction technique that extends traditional ARIMA models that predict based on historical patterns in changes of price, by integrating news sentiment and credibility analysis together with technical and macroeconomic indicators. Unlike existing approaches that rely completely on historical price trends, our model dynamically adjusts predicted prices based on real-time external influences, offering a forecasting system aware of context. The main contributions of this work are adjusting prices on different factors, using news sentiment, credibility and longevity scores. The reliability of the news is evaluated for reducing impact of misinformation on prices. Financial indicators like unemployment rate are also included for a broader perspective of the economic situation and the app has an integrated simulated trading platform for practical experience to fill the gap between theoretical and real-world investment decisions.

By integrating all these components together, this model makes stock price prediction more accurate and provides a support tool for investors' decisions.

1.5 Thesis Structure

This paper was structured in 6 chapters, the current chapter which summarizes the background of stock markets together with the concepts that investors use for making decisions and the importance of financial literacy, motivation of this paper with its structure. The second chapter 2 reviews previous studies and existing solutions in the field, highlighting methodologies and limitations, providing comparisons of other models and techniques used in literature. Third chapter sets the

theoretical concepts (natural language processing and text classification using transformers, the statistical foundation for time series models) needed to understand the implementation, the next chapter is representing the details of the implementation, describing data collection, processing and training for the models and the functionalities available on the graphical user interface and backend. The last 2 chapters include drawing a conclusion based on the results of the models and the future work, adjustments and ideas to be implemented for a better and more accurate experience.

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Chapter 5

Results and Conclusion

Chapter 6

Future Work

Bibliography

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