

Developing a Web Application for Financial Statement Analysis: A User-Centric Approach

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Abstract- This application is designed to streamline the analysis of financial statements by allowing users to easily upload company data for comprehensive evaluation. By leveraging advanced algorithms, the application conducts thorough ratio analysis and trend analysis, converting raw financial data into meaningful visual insights, including graphs, pie charts, and heatmaps. These visual representations enhance the understanding of a company's financial health, revealing trends and performance metrics over time. In addition to historical analysis, the application incorporates sophisticated predictive analytics to forecast the company's financial performance over the next five years. This feature enables stakeholders to make informed strategic decisions based on projected outcomes. By integrating historical data analysis with predictive modeling, this tool empowers investors, financial analysts, and business managers to identify potential risks and uncover growth opportunities. Ultimately, the application enhances financial decision-making capabilities, providing users with a robust framework for evaluating company performance and making strategic investments. With its user-friendly interface and powerful analytical features, this application is poised to revolutionize how financial data is interpreted and utilized.

Index Terms- Ratio Analysis, Trend Analysis, Stakeholder, Financial Analyst.

I. INTRODUCTION

It has been observed that in a fast-changing financial environment, it is not just advantageous but necessary to predict the future performance of any financial undertaking using past data. In this paper, we develop an advanced financial statement analyzer for easy uploading of data for a company for its predictive analysis. Using trend analysis and ratio analysis and applying logistic regression along with NumPy, advanced libraries for machine learning, we have attempted to improve the precision of financial forecasting.

Financial statement analysis is an essential tool in evaluating a firm's operational efficiency, liquidity, and overall financial health. Trend analysis enables the comparison of historical performance over time to identify patterns for informing future expectations. Ratio analysis, however, is necessary for making vital comparisons along different financial dimensions that explain relationships between metrics which are critical for good judgment.

Our analyzer integrates logistic regression-a very powerful statistical method for analyzing data whose outcome is categorical- with powerful machine learning libraries in order to deliver exact predictions that suit the requirements of the various stakeholders. They include investors, analysts, and corporate managers. Besides the fact that such libraries like

NumPy are capable of easy manipulation of the data as well as facilitating its analysis, the computation of the model's power will also be greatly improved for real-time insights in terms of financial viability.

We look at the methodology that enabled developing this analyzer, from which a data processing pipeline emanated into the statistical models used for their implementation and the repercussions our findings may have toward informing investment decisions by other stakeholders. We hope thereby to contribute to the steadily expanding field of financial analytics as a source of practitioner aid in dealing with challenges posed by financial forecasting in all its aspects.

II. THEORETICAL CONCEPTS AND TOOL

1. Trend Analysis

is a fundamental technique in financial analysis that involves examining financial data over a specified period to identify patterns, fluctuations, and overall directions. This method can be used to assess growth trajectories, seasonal variations, and cyclical trends. The process typically involves the following steps:

Data Collection: Historical financial data, such as income statements and balance sheets, are collected for the period under analysis.

Data Visualization: Graphical representations (e.g., line charts) depict key financial metrics over time, making it easier to identify trends.

Calculating Growth Rates: Growth rates are calculated for various financial metrics (e.g., revenues, expenses, net income) to quantify trends.

Moving Averages: Techniques such as simple moving averages can smooth out short-term fluctuations and highlight longer-term trends, providing clearer insights.

2. Ratio Analysis

Ratio analysis involves the evaluation of financial statements by calculating and interpreting key ratios that provide insights into a company's performance relative to its peers. Key aspects of this approach include:

Identification of Key Ratios: Common ratios encompass liquidity ratios (e.g., current ratio), profitability ratios (e.g., return on equity), and solvency ratios (e.g., debt-to-equity ratio).

Benchmarking: Ratios are compared against industry averages or historical data to assess relative performance.

Interpretation: Each ratio provides a unique perspective; for example, a high current ratio might indicate strong liquidity, while a low return on equity could signal inefficiencies.

Trend Analysis of Ratios: Ratios are analyzed over time to identify improving or deteriorating financial health.

3. Logistic Regression

Logistic regression is a statistical method used for modeling the relationship between a dependent categorical variable and one or more independent variables. In the context of financial statement analysis, logistic regression can be applied to predict binary outcomes, such as the likelihood of bankruptcy or fiscal distress. The methodology involves:

- **Defining the Dependent Variable:** The outcome of interest (e.g., financial distress) is defined as a binary variable (1 for distress, 0 for non-distress).
- **Selecting Independent Variables:** Financial ratios and trends identified in the previous analyses are used as independent variables.
- **Model Fitting:** The logistic regression model is fitted using maximum likelihood estimation to estimate the coefficients of the independent variables.
- **Model Evaluation:** The model's accuracy is evaluated using metrics such as the confusion matrix, accuracy score, precision, recall, and F1 score.

4. Machine Learning Libraries

Utilizing machine learning libraries is crucial for data manipulation, visualization, and model development in our

financial statement analyzer. Below are key libraries that play significant roles in the data analysis process:

- **NumPy:** NumPy is a fundamental package for numerical computations in Python. It provides support for multi-dimensional arrays and matrices, along with a collection of mathematical functions to operate on these data structures. NumPy is essential for efficiently handling large datasets, performing complex mathematical calculations, and enabling fast data manipulations, which are critical in financial analysis.
- **Pandas:** Pandas is an open-source data manipulation and analysis library that offers data structures like DataFrames, which allow for easier data handling compared to traditional Python lists. With Pandas, we can clean, transform, and analyze financial datasets efficiently. The library provides powerful capabilities for filtering, aggregating, and merging datasets, making it indispensable for preprocessing financial statements before applying advanced analytical techniques.
- **Matplotlib:** Matplotlib is a widely used plotting library in Python that enables the visualization of data through various types of plots, including line charts, bar charts, and histograms. In the context of financial analysis, Matplotlib helps visualize trends over time, compare financial ratios, and display important metrics. Visualizing data is vital for uncovering insights and supporting narrative explanations of financial performance.
- **Seaborn:** Built on top of Matplotlib, Seaborn is a statistical data visualization library that provides a high-level interface for drawing attractive and informative statistical graphics. Its capability to create complex visualizations with less code makes it particularly useful for financial analysis. By visualizing distributions and relationships between different financial metrics, Seaborn aids in identifying trends and anomalies that may warrant further investigation.
- **scikit-learn (Sklearn):** Scikit-learn is a powerful and user-friendly machine learning library that provides various tools for model building, evaluation, and selection. It includes implementations of various algorithms, including logistic regression, decision trees, and ensemble methods. In our financial statement analyzer, Sklearn is used to build predictive models based on the processed financial data, allowing for the exploration of relationships among different financial indicators and forecasting future performance.

III. LITERATURE REVIEW

In reviewing a range of studies and papers focused on financial statement analysis, it became apparent that many calculations are conducted using Excel spreadsheets. While Excel is a powerful tool for data organization and

computation, this reliance introduces a significant potential for human error and can become time-consuming, taking resources that could be better utilized for strategic financial decision-making.

For instance, the study by Faruk Hossan and Md Ahsan Habib "Performance evaluation and ratio analysis of Pharmaceutical Company in Bangladesh" illustrates how manual calculations in Excel can lead to inconsistencies, as shown in Figure 1 below:

Table: 4.2.1 Accounts receivable turnover ratio

Year	Beximco Pharmaceuticals Ltd. (Ratio)	Square Pharmaceuticals Ltd. (Ratio)
2008	(1) 4,010,167,059 ----- = 7.958	8,257,843,739 ----- = 5.466
	(2) 503,916,401	1,510,502,334
2007	(1) 3,597,024,812 ----- = 7.198	7,500,811,349 ----- = 5.286
	(2) 499,680,792	1,418,893,703

Figure: 4.2. 1. Accounts receivable turnover

Figure 1: Excerpt from Faruk Hossan and Md Ahsan Habib work, highlighting the methods of financial analysis performed in Excel, which can introduce potential errors.

Moreover, many existing tools lack the capability to present data in intuitive visual formats, such as graphs and charts, which are crucial for effective analysis and understanding of financial trends. This limitation is evident in Vincent Okoth Ongore and Gemechu Berhanu Kusa findings, wherein the reliance on Excel for data representation is noted but fails to leverage visual analytics. The screenshot in Figure 2 below captures this shortcoming:



Figure 2: Excerpt from Vincent Okoth Ongore and Gemechu Berhanu Kusa, showcasing how financial data is presented in Excel without utilizing advanced graphical representations.

Recognizing these limitations, we decided to develop an application designed to automate financial calculations that are traditionally performed in Excel and present results in an easily digestible visual format. The proposed application will utilize advanced algorithms to perform real-time data processing, enabling users to visualize their financial metrics and trends through comprehensive graphs and charts. By addressing the gaps identified in the current literature, this project aims to enhance user experience and facilitate better financial decision-making

Objective of Study

The key objectives of this research work are to develop a user-friendly web application that simplifies the process of financial statement analysis so that it is accessible to a diverse user base of investors, financial analysts, and students, thereby making the access of financial analysis easier to the users by making them access the application from any device connected with the internet, thus making real-time analysis and decision-making possible regardless of location.

- **To Simplify the Process of Financial Analysis:** Unify data entry, calculation, and visualization into one platform that reduces the intricacy of financial analysis to enable users to focus on the interpretation of results.
- **To include Real-time Data Integration:** Make it possible for users to upload financial statements or use real-time financial data so that the analyses performed will be more relevant and accurate.
- **To Offer Education:** Create the application so that it has built-in tutorials and user-friendly interfaces that would guide the users in understanding financial analysis techniques and concepts, thereby becoming a learning tool.
- **To Provide Customizable Reporting Features:** Allow the users to generate reports and visualizations that are customized according to their analytical requirements, enabling them to draw detailed comparisons between companies, sectors, or financial metrics.
- **To Contribute to the FinTech Landscape:** Position the application as an innovative tool within the FinTech sector, demonstrating how modern web technologies can enhance financial analysis and inspire further advancements in automated financial reporting.

IV. RESEARCH METHODOLOGY

1. Data Sources

Alpha Vantage API will be used for the real-time stock market data for the application and will use Plaid for secure login to the bank accounts by users, which in turn will allow automatic data fetching for both transactions and balances to be realized.

2. Technology Selection

While using JavaScript on the front-end (eg. frameworks such as HTML, and CSS is optional), the back-end paving will be supplemented with tools such as Neijs Express.js. Other supported languages may be Python frameworks such as lightweight & flexible Flask or batteries included Django, Java framework Spring Boot).

Control over user permissions is done through Bursary & UI down-reverse Facebook. Users need to secure their data through good security techniques and technologies. Therefore, encryption libraries such as PyCrypto for Python, Crypto for Node.js, and Java's Cryptography APIs for the secure

transmission of data are used in addition to HTTPS and TLS. Along with secure session management through the 3rd party libraries, other frameworks like OAuth2.0 and OpenID Connect will use a crypto key to ensure secure communication. Using hashing algorithms such as SHA-256 will ensure that sensitive information is protected and that existing industry standards and regulations are met. The application should incorporate logistic regression algorithms to help predict data behavioral patterns and the potential financial states. Hence, statistical tools are made available for users to utilize when they make their decisions.

Namely, NumPy which will provide fast numerical computations and on top of that Pandas for easy data manipulation and analysis will be bundled with Matplotlib and Seaborn for visualization. As a result, users will be able to grasp the fundamental principles underlying the financial data properly. Also, an additional tool, Scikit-learn will be used to implement and evaluate the machine learning models. This will not only enhance the application's analytical capabilities but also, customers can obtain actionable insights from their financial statements.

3. Analysis of Data: Tools & Techniques

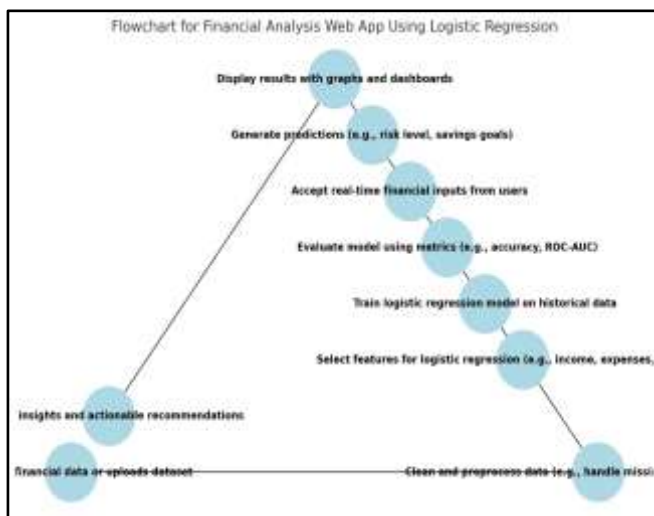
In this Research Method we have used:

Financial tools-

- Ratio analysis
- Trend analysis
- Statistical tools

V. DEVELOPMENT PROCESS

The application architecture consists of a single-page application (SPA) built on React front-end. The database will be designed using MongoDB, supporting flexible data models for user profiles and financial records.



Features of the Application

Core Features

- **Data Upload:** Users can upload financial statements in various formats (e.g., CSV, Excel).
- **Data Preprocessing:** The application will preprocess the data using Pandas and NumPy, handling missing values, outliers, and data normalization.
- **Logistic Regression Analysis:** The application will perform logistic regression analysis using Scikit-learn to identify trends and patterns in the financial data.
- **Machine Learning Model Training:** The application will train machine learning models using Scikit-learn to predict financial outcomes.
- **Results Visualization:** The application will display the results in the form of interactive graphs, charts, and tables using Matplotlib and Seaborn.

2. Advanced Features

- **Financial Ratio Analysis:** The application will calculate various financial ratios (e.g., debt-to-equity, current ratio) to provide insights into a company's financial health.
- **Predictive Modeling:** The application will use machine learning algorithms to predict future financial outcomes based on historical data.
- **Alerts and Notifications:** The application will send alerts and notifications to users when significant changes or trends are detected in the financial data.

3. Security and Compliance Features

- **Data Encryption:** The application will encrypt financial data to ensure confidentiality and security.
- **Access Controls:** The application will provide role-based access controls to ensure that only authorized users can access and analyze financial data.

VI. CONCLUSION

This paper presents the design and validation of a web application designed to cater for personal financial analysis, which indeed meets the needs expressed by the target users. The web application uses logistic regression and libraries in machine learning, NumPy, Scikit-learn, Matplotlib, and Pandas, to analyze financial statements. The output of the analysis is then presented in an easy-to-understand manner using graphs and charts for easier decision-making.

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