International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 22 No. 3 (2026)

ijerst.editor@gmail.com

editor@ijerst.com

ISSN 2319-5991 www.ijerst.com

Peer Reviewed, Referred & Indexed Journal

Research Paper

OptiWise: A Web Based AI-Driven Decision Intelligence System with Explainable AI For Business Data Analytics

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Abstract: Modern businesses deal with enormous amounts of structured data generated from sales activities, customer interaction, financial processes, inventory management, and other business processes. It is crucial to convert such data into knowledge to be used in business decision-making. However, traditional BI systems only produce dashboards and reports that require manual interpretation and do not give enough intelligent decision-making support. This work introduces OptiWise – a web-based AI-based decision intelligence system that includes automated data preprocessing, exploratory data analysis, dynamic data visualization, predictive analytics, XAI, AI-produced executive summaries, business recommendations, conversational analytics, dataset exploration, and PDF reports generation in one application. The system takes business datasets in structured format, validates and pre-processes it automatically, and generates suitable visualizations and business metrics dynamically without any configuration needed. In case the proper target variable is selected, the Random Forest algorithm is used for predictive analytics, whereas feature importance analysis gives transparent explanation of prediction results. An AI chatbot allows to interact with uploaded datasets in natural language and get instant business insights. Experimental evaluations show the effectiveness of the proposed system in terms of automation of business analytics, Explainable AI, reduced effort, and informed decision making. Overall, OptiWise provides a scalable, user-friendly, and intelligent solution for modern business analytics.

Keywords: Business Analytics, Decision Intelligence, Explainable Artificial Intelligence, Machine Learning, Conversational Analytics, Decision Support System.

1. INTRODUCTION

The rapid development of digital technologies has resulted in an increase in the volume of data that is created by modern enterprises. There is a huge amount of structured data generated by the processes of sales, customer relations management, inventory management, accounting, logistics, and marketing. The analysis of the data is essential to identify the trends of businesses, evaluate the performance of the enterprise, improve the performance of the company, and make proper decisions. However, the process of analyzing big and complicated data sets is rather challenging for companies.

For many years, the technology of Business Intelligence (BI) has been widely used to transform business data into information through reporting, dashboards, and visualization. Using BI systems, it is possible to measure performance indicators and evaluate the performance of the business using descriptive analytics. Despite the valuable features of BI systems, the major problem of such systems is

their focus on data visualization and the need to manually analyze reports and charts before making any decisions.

The latest improvements in artificial intelligence (AI) and machine learning (ML) have greatly benefited business analytics by introducing pattern recognition, prediction modeling, and decision support through automation. Machine learning algorithms are able to process datasets, find hidden connections between business-related variables, and predict which helps organizations to plan and make decisions. There are many machine learning algorithms, however, the Random Forest algorithm is one of the most popular ones because of its robustness, ability to work with complicated datasets, absence of overfitting, and feature importance estimation.

Nevertheless, there exists one problem with the use of analytical models developed by AI algorithms – these models are black-box models because they do not explain how the prediction is made. In order to apply such a prediction in practice, people who are responsible for making managerial decisions require information about the way predictions are made. Explanable Artificial Intelligence (XAI) solves the problem of explainability which is essential for any application of machine learning algorithms in business. Feature importance analysis provides users with information about the significance of certain variables in predictions.

In addition to the mentioned Predictive Analytics and Explainable AI, the progress made in recent times in terms of Generative AI has created new possibilities for intelligent business analytics. The large language models (LLMs) available from such providers as Google Gemini API allow a system to generate natural language summaries, recommendations, and responses based on the analytical findings. Rather than going through dashboards and statistical reports by themselves, the users will be able to receive insights regarding their businesses in natural language and ask questions about their data sets using conversations.

While much research has been done in such areas as Business Intelligence, Machine Learning, Explainable AI, and Conversational Analytics, existing solutions cover mostly one aspect of business decision making. Traditionally, BI platforms are oriented mostly at reporting and visualization, while machine learning and other AI systems concentrate on predictive performance alone without any explainability and interaction with the user. Meanwhile, conversational analytics platforms lack visualization, automatic recommendations, and reporting abilities altogether. Because of that, many companies need to use a combination of different systems in order to conduct different stages of business analytics.

In order to address the limitations identified above, this study suggests the development of an OptiWise Web-based AI-driven Decision Intelligence System for Business Data Analytics. OptiWise represents a combination of automated data preprocessing, exploratory data analysis, dynamic visualization, predictive analytics using the Random Forest algorithm, Explainable Artificial Intelligence (Explainable feature importance analysis), AI-generated executive summaries, business recommendations, conversational analytics, dataset exploration, and automated PDF reports generation. As opposed to the traditional BI systems that work with predefined dashboards, OptiWise will dynamically adjust to different structured business datasets and automatically generate suitable visualization and other outputs.

OptiWise is developed using React.js for frontend components and Flask for backend services. Data preprocessing and data manipulation with business datasets is performed using Python, Pandas, and NumPy libraries. The Random Forest algorithm is used to perform predictive analytics, implemented using Scikit-learn library. Explainable AI is implemented using Explainable feature importance analysis. The executive summary, business recommendations, and conversational analytics are performed by integrating Google Gemini API.

The significant contributions made by this research include the creation of OptiWise, an integrated web-based Decision Intelligence system that combines Business Intelligence, Machine Learning, Explainable Artificial Intelligence (XAI), and Generative AI to provide intelligent business analytics services. The developed system features an automated analytics process that validates, preprocesses, analyses, visualizes, predicts, recommends, engages in conversation, and generates PDF reports on datasets with minimum user intervention. In order to ensure transparency and build trust from the users, the system incorporates Random Forest algorithms with feature importance analysis, allowing Explainable Artificial Intelligence to explain prediction results. Moreover, the Google Gemini API is employed for generating executive summaries, business recommendations, and conversational answers through the AI-driven chatbot. The developed framework is evaluated in experiments with structured business datasets.

2. LITERATURE REVIEW

The introduction of Business Intelligence (BI), Explainable Artificial Intelligence (XAI), Machine Learning (ML), and conversational analytics has revolutionized decision-making by allowing intelligent data analysis and predictions. Various scholars have come up with approaches aimed at enhancing business analytics through artificial intelligence (AI).

Choudhari and Kulkarni (2026) suggested the use of a Conversational Business Intelligence Platform that allows interaction with business data using natural languages in order to automate analytics and decision making [1]. With this approach, the process of exploring data is simplified, and accessibility enhanced by offering conversational interfaces. Nevertheless, the system only considers conversational business intelligence and does not consider explainability, prediction, recommendation generation, and automated report generation as an integrated concept.

Kamis (2026) carried out an extensive review of the studies done about Business Analytics, Machine Learning, and Generative Artificial Intelligence from the year 2020 to 2025 [2]. In his review, he discussed the role of AI in business intelligence and emphasized the importance of responsible AI in improving the decision-making processes. Although the review gives insights into various technological innovations, no frameworkis proposed for integrating machine learning, explainability, visualization, and conversational analytics into one decision support system.

Mersha et al. (2025) performed a thorough review of Explainable Artificial Intelligence, explaining its needs, methods, use cases, and future research opportunities [3]. It is noted that explainability increases transparency, fairness, accountability, and trust in AI systems. However, the paper provides only a review of XAI techniques and does not prove their implementation in real-world business analytics platforms.

Singh (2025) created Explainable AI solutions for Enterprise Decision Support Systems to make the process of decision-making in organizations more transparent and reliable [4]. This study proves the need for interpretable machine learning models in the enterprise context. Nonetheless, the technique suggested in the paper focuses only on explainability and does not include dynamic visualization, conversational analytics, or AI-based business recommendations.

Paliwal et al. (2025) reviewed the transformative power of Explainable Artificial Intelligence in different application areas [5]. It is explained how XAI can help in closing the gap between sophisticated machine learning algorithms and users' trust through enhancing interpretability and accountability. Despite a comprehensive analysis of XAI approaches, there is no solution proposed for the development of a full-fledged intelligent business analytics system.

Marin Diaz, Gomez Medina, and Aijon Jimenez (2025) suggested a research methodology that is based on a combination of Explainable AI and the Analytic Hierarchy Process (AHP) in business decision-making [6]. The suggested framework shows the way in which explainable machine learning contributes to decision quality through multi-criteria decision analysis. However, the study is devoted mainly to the methods of decision-making and does not include any features of visualization, conversational analytics, or intelligent reporting.

Neri et al. (2025) carried out the systematic review of data visualization in decision-making assisted by artificial intelligence [7]. It is shown that the role of interactive visualizations is critical for users' comprehension of AI insights and improved decision-making. Though the topic of visualization is widely covered in this research, machine learning prediction, Explainable AI, or conversational interfaces are not included in one framework.

Vasugi (2025) developed an XAI framework that is dedicated to business and healthcare analytics and used for financial risk assessment and decision-making [8]. It is shown that the proposed methodology is effective for improving transparency and confidence of analytical models. However, the framework is domain-oriented and does not provide any automatic data preprocessing, conversational analytics, or visualization dashboards.

Kumar et al. (2024) explored the application of Machine Learning and Data Science in achieving decision-making optimization in engineering and computer applications [9]. The researchers showed that machine learning approaches may significantly enhance the precision of predictions and contribute to intelligent decision making in several areas. Yet, the research is limited to machine learning approaches and does not offer an adequate business analytics solution with explanations and interaction.

Kostopoulos, Davrazos, and Kotsiantis (2024) offered a detailed overview of the Decision Support Systems based on Explainable Artificial Intelligence [10]. The scholars discussed the progress in XAI and its applications for improving decision support systems along with several approaches for explaining decisions. Though the literature review contains rich theoretical background, it does not offer an integrated solution combining Business Intelligence, XAI, conversational analytics, predictive modeling, and automated reports.

While there have been remarkable advancements made in the past studies, the major challenge is that most of the approaches in use consider individual elements, such as conversational business intelligence, Explainable AI, machine learning, and visualization. There are very few approaches which combine automated data preprocessing, exploratory data analysis, dynamic visualization, prediction, Explainable AI, AI-generated executive summaries, business recommendations, conversational analytics, dataset

exploration, and automated PDF reports in one web application. To overcome the limitations of the past studies, this paper presents OptiWise, an AI-powered Decision Intelligence System.

2.1 Comparative Analysis of Existing Approaches

Many recent studies have significantly contributed to the development of Business Intelligence, Explainable Artificial Intelligence (XAI), Machine Learning, and AI decision support systems. Thus, in their study, Choudhari & Kulkarni (2026) [1] proposed an approach for designing a conversational Business Intelligence platform, however, without applying Explainable AI and predictive analytics. The review conducted by Kamis (2026) [2] examined trends in research related to Business Analytics, Machine Learning, and Generative AI but mostly concentrated on responsible AI, not proposing any integrated approach. Mersha et al. (2025) [3] and Kostopoulos et al. (2024) [10] carried out a literature review of the XAI approaches and benefits related to transparency of AI but were mainly engaged in theoretical research. Singh (2025) [4], Paliwal et al. (2025) [5], and Vasugi (2025) [8] emphasized the importance of applying XAI in decision making but did not integrate visualization, conversational analytics, and auto reports. Similarly, Marín Díaz et al. (2025) [6], Neri et al. (2025) [7], and Kumar et al. (2024) [9] made valuable contributions in AI-assisted decision making via decision frameworks, visualization, and machine learning, respectively. Nevertheless, all of the above-mentioned papers focus on different parts of business analytics.

2.2 Research Gap

The literature review reveals that considerable progress has been achieved in areas of Business Intelligence, Machine Learning, Explainable Artificial Intelligence (XAI), and decision support systems with AI involvement. Nevertheless, the vast majority of existing methods concentrate on particular functionality like visualization, explainability, conversational analytics or prediction rather than offer an all-in-one solution for business analytics. Conventional BI systems offer mostly descriptive analytics via dashboards and reports, whereas researches on XAI technologies concentrate on the transparency of the models while ignoring recommendation generation and interactive analytics. Likewise, conversational BI solutions improve the user interaction while failing to include the predictive analytics, Explainable AI and automatic report generation.

Moreover, businesses often employ several different tools for data preprocessing, visualization, predictive analytics, explainability and report generation, which makes the process more complicated, lengthy and expensive. In order to overcome these shortcomings, the current research aims to present OptiWise, a web-based AI-driven Decision Intelligence System incorporating automated data preprocessing, dynamic visualization, predictive analytics based on the Random Forest algorithm, explainability by way of feature importance analysis, AI-driven business insights powered by Google Gemini API, conversational analytics, and automated generation of PDF reports.

3. METHODOLOGY

The proposed OptiWise methodology involves a set of systematic steps to automate the entire business analytics process from structured dataset upload to intelligent decision making and automated report generation. The methodology involves several related modules for processing structured business datasets, performing analytics, generating predictions, and providing AI-based recommendations. With the automation of these steps, the methodology minimizes human intervention while ensuring a highly interactive and user-friendly analytics environment. The whole workflow of the proposed methodology is shown in Figure 1.

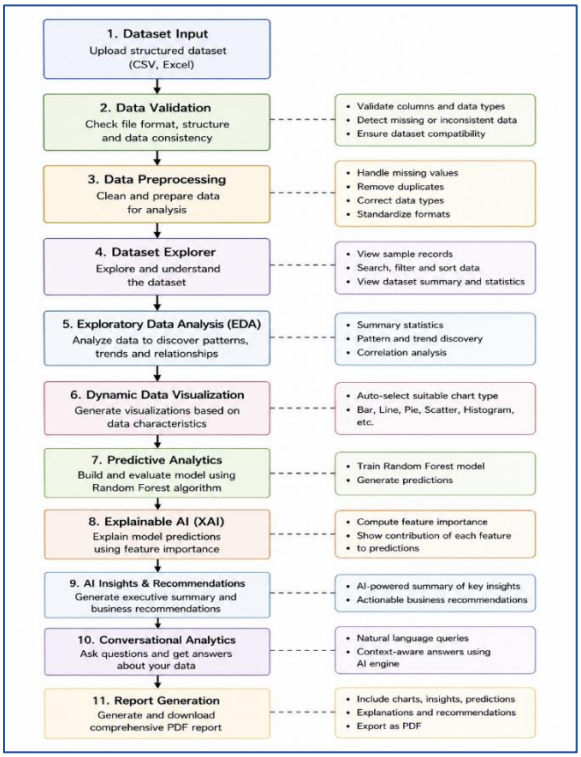

Figure 3.1 Workflow of the Proposed OptiWise Decision Intelligence System

3.1 Dataset Acquisition and Preprocessing

The proposed OptiWise framework begins by accepting structured business datasets in formats such as CSV and Microsoft Excel (.xlsx) through a web-based interface. After the dataset is uploaded, the system validates the file format

and dataset structure to ensure compatibility with the analytical modules. During preprocessing, the framework handles missing values, removes duplicate records, and corrects inconsistent data to improve data quality before analysis.

The uploaded dataset can be shown as:

$$D = \{x1, x2, \dots, xn\}$$

Where D represents the input dataset with n records.

After the preprocessing step is completed, the dataset can be presented as follows:

$$Dp = Preprocess(D)$$

Where Dp represents the processed dataset.

3.2 Exploratory Data Analysis and Dynamic Visualization

Upon preprocessing, the Dataset Explorer allows users to examine data records, conduct search operations on the data, and apply filters. The system will proceed to carry out Exploratory Data Analysis (EDA) by determining numerical and categorical attributes from the data automatically.

Depending on the data type, the Dynamic Visualization component automatically picks appropriate visualization methods, which include bar charts, line charts, pie charts, scatter diagrams, and histograms. In contrast with standard dashboards where the configuration of the chart is done manually, the suggested system automatically creates visualizations based on the uploaded dataset's nature.

This can be defined as:

$$V = f(Dp)$$

where V refers to the generated visualizations and f(Dp) is the visualization selection function.

3.3 Predictive Analytics and Explainable Artificial Intelligence

Once the loaded dataset contains the appropriate target variable, the system applies the Random Forest algorithm for making predictions. The trained model will generate the prediction output and calculate the feature importance value.

The equation for the prediction function is:

$$\hat{y} = RF(X)$$

where X is the list of features, RF is the Random Forest model, and ŷ is the output value.

In order to increase transparency, Explainable Artificial Intelligence (XAI) calculates the feature importance value:

$$FI = \{f1, f2, \dots, fm\}$$

where FI is the set of feature importance values, while $f1, f2, \dots, fm$ are feature importance values.

3.4 Ai-Based Decision Support

The analysis results of the system are analyzed through the Google Gemini API in order to receive the executive summary and recommendations for companies. The user does not have to analyze the analytical reports himself but receives the explanation and recommendations in natural language.

The process of generating an AI-based summary can be described as follows:

$$S = Gemini(A)$$

A is the analytical report, while S is the generated executive summary and recommendations.

This technology also includes a feature called Conversational Analytics, which allows analyzing the data from the uploaded dataset in natural language. The chatbot answers the users' questions based on the analysis results.

3.5 Report Generation

Finally, all analytical outputs are consolidated into a comprehensive PDF report containing visualizations, prediction results, Explainable AI insights, executive summaries, and business recommendations. The report generation module automatically formats these outputs into a downloadable document for business reporting and decision-making.

Overall, the proposed methodology integrates automated data preprocessing, exploratory data analysis, dynamic visualization, predictive analytics using the Random Forest algorithm, Explainable Artificial Intelligence through feature importance analysis, AI-based decision support, conversational analytics, and automated report generation within a unified framework. This integrated workflow reduces manual effort, improves interpretability, and supports effective business decision-making.

4. PROPOSED FRAMEWORK

4.1 Framework Overview

The proposed OptiWise framework is a web-based Decision Intelligence System that automates the entire business analytics process through the use of Artificial Intelligence and Machine Learning. The framework encompasses Business Intelligence, Predictive Analytics, Explainable Artificial Intelligence (XAI), Conversational Analytics, and AI-assisted decision-making in a single system. The

difference between the framework and conventional BI toolkits which majorly emphasize descriptive reporting is that the proposed framework merges data preprocessing, data visualization, prediction, explanations, business advice, and reporting into one platform.

The design of the framework caters for both technical and non-technical analysts through automating analytical processes and employing natural language interactions. Data from the users is accepted in a structured form (CSV, Microsoft Excel files (.xlsx)) and analyzed through several analytical modules to deliver valuable insights and advice for business decisions. The architectural overview of the proposed OptiWise framework is demonstrated in Figure 2.

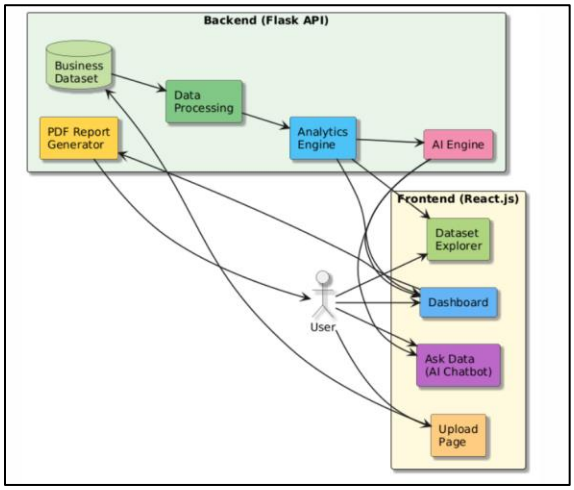

Figure 4.1 Architectural Overview of the Proposed OptiWise Framework

4.2 Components of Framework

The designed framework is composed of five key functional components that cooperate to conduct the process of business analytics.

Dataset Management Component:

It is used to manage the tasks related to the processing of the input dataset. They include uploading the data file, checking the validity of the file, dealing with duplicates, removing the missing values, and making the dataset ready for further analyses.

Data Analytics Component:

Exploratory Data Analysis (EDA) is conducted with the help of the processed dataset. Statistical descriptions of the dataset and visualization of the information contained in it are carried out with this component. It provides automatic visualization depending on the characteristics of the dataset that has been uploaded. There are search, filter, and sort capabilities provided in this component.

Predictive Analytics Component:

Whenever a suitable target is available, the Random Forest algorithm is used to generate predictions.

Explainability AI and Decision Support Component:

In order to increase clarity, the Explainable Artificial Intelligence (XAI) module provides scores that indicate the importance of particular features in the prediction outcomes. All the analytical outcomes are then processed with the help of Google Gemini API in order to produce executive summaries, business recommendations, and conversational responses with natural language processing.

Report Generation Component:

The last module generates a report in PDF format that incorporates all the analytical outcomes, including visualizations, prediction results, Explainable AI results, executive summaries, and business recommendations.

4.3 Framework Architecture and Data Flow

The architecture of the proposed OptiWise framework is modular and involves each component carrying out a certain analytical operation while communicating with other modules. The first step of the process is carried out by the Dataset Management module and includes uploading, validating, and preprocessing of structured datasets. The preprocessed dataset is transferred further to the Data Analytics module, which is responsible for exploratory analysis, calculations, and dynamic visualization.

The Prediction Analysis module is used to produce prediction outputs through the Random Forest algorithm and further interpretation of the model by the Explainable Artificial Intelligence module. The outputs of these analytical operations are being processed further by the AI-based Decision Support module that uses the Google Gemini API to create executive summaries, business advice, and conversational answers. All the outputs produced by the framework are assembled into one downloadable PDF report by the Report Generation module.

This architectural structure allows independent processing of each analytical process and its interaction with other modules.

4.4 Features of the Proposed Framework

There are certain key features implemented in the OptiWise framework that allow users to benefit from its use and make the business analytics process more efficient and convenient for them. Firstly, the framework performs automatic

preprocessing of uploaded datasets that saves time and ensures the high quality of data analysis. Besides, it is able to dynamically generate visualizations depending on the features of datasets, without manually configuring charts.

Moreover, the inclusion of the Random Forest algorithm allows implementing predictive analytics, and the implementation of the Explainable Artificial Intelligence allows achieving better transparency through the feature importance analysis. Finally, the inclusion of the Google Gemini API allows implementing AI-generated executive summaries, business recommendations, and conversational analytics through natural language questions. Thus, by integrating these features into one solution, the proposed framework increases interpretability and makes interactions with the system more convenient.

5. RESULTS AND DISCUSSION

The proposed OptiWise framework has been implemented and tested on structured business data in CSV and Microsoft Excel (.xlsx) formats. The testing has been carried out to ensure the working of each of the components included in the proposed framework such as data preprocessing, exploratory data analysis, dynamic visualization, predictive analytics, XAI, AI-based decision support, conversational analytics, and automated reporting. The results obtained from experiments validate the performance of the proposed framework in automating business analytics and decision-making process.

5.1 Data Set Upload and Validation

The system successfully uploads and validates structured data sets in CSV and Excel (.xlsx) format prior to analysis. This process makes sure that data is compatible and ready for pre-processing and analytics.

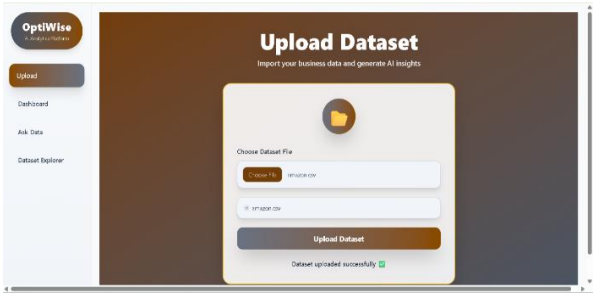

Figure 5.1 Data Set Upload and Validation Module

5.2 Dashboard and Business Analytics

The dashboard shows essential business metrics and summary information about analytics automatically. It helps users get an overview of the uploaded data set and allows performing business analytics efficiently.

Figure 5.2 Business Analytics Dashboard

5.3 Data Set Explorer

The Data Set Explorer tool allows searching, filtering, sorting and viewing records of the data set. It helps in exploring data and making it accessible for further business analytics.

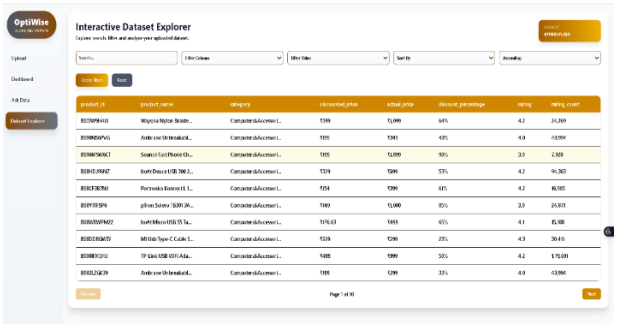

Figure 5.3 Data Set Explorer Module

5.4 Dynamic Data Visualizations

The system automatically generates visualizations depending on the uploaded data set. Such visualizations include bar charts, line charts, pie charts, scatter plots, histograms and other types of diagrams.

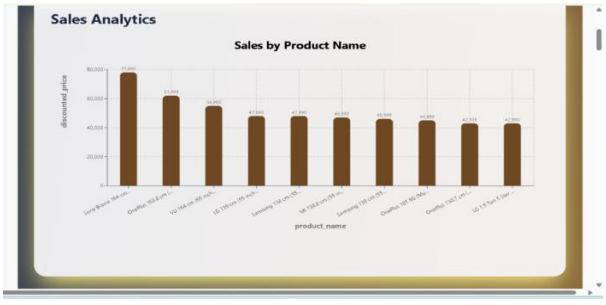

Figure 5.4 Automatically Generated Charts

5.5 Explainable Artificial Intelligence (XAI)

In the Explainable AI module, feature importance values are calculated to detect which variables exert the maximum impact on predictions.

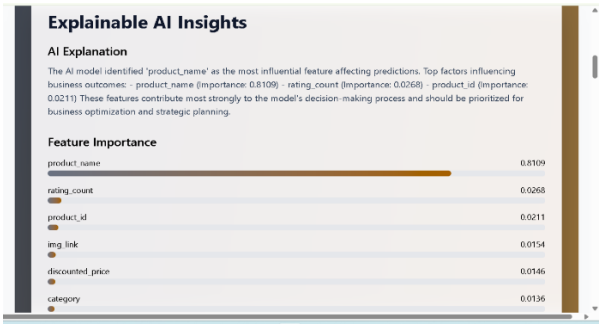

Figure 5.5 Feature Importance Analysis

5.6 AI-Generated Executive Summary and Business Recommendations

The Google Gemini API produces executive summaries and business recommendations based on analytical outcomes. The use of such AI-based capabilities is helpful for data understanding and decision-making.

Figure 5.6 AI-Generated Executive Summary

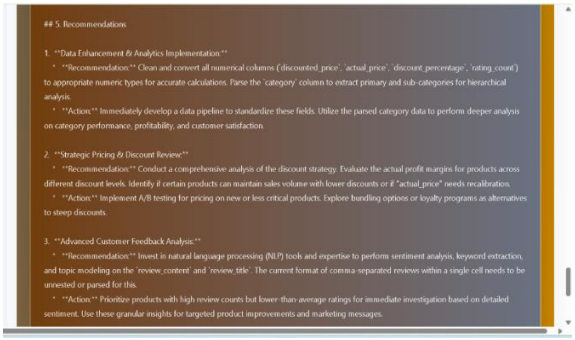

Figure 5.7 AI-Generated Business Recommendations

5.7 Conversational Analytics

The conversational analytics module lets users interact with the dataset by formulating natural language queries. In response, the Google Gemini API produces appropriate context-aware messages, making business analytics interactive.

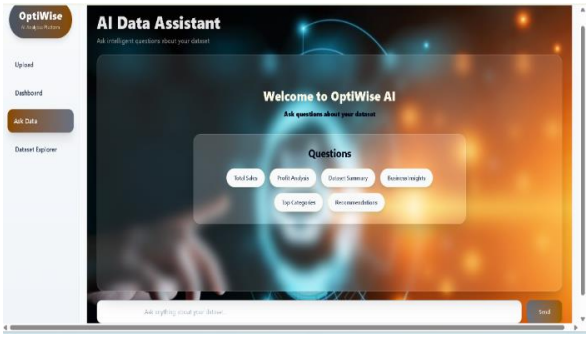

Figure 5.8 Conversational Analytics Module

5.8 Discussion

According to the experimental results, the proposed OptiWise framework effectively combines the data preprocessing, EDA, dynamic visualization, predictive modeling, XAI, AI-driven decision support, conversational analytics, and automatic reports generation into one framework. The framework is capable of completely automating the business analytics workflow with minimal human intervention and maximizing the interpretability of analytical findings. In addition, the use of the Google Gemini API contributes to enhancing the decision support capability through generating executive summaries and business recommendations. The system saves effort, increases the interpretability of results, and offers efficient assistance for making decisions in a business environment.

6. CONCLUSION

OptiWise is the web-based AI-based Decision Intelligence System designed for simplifying and automating business analytics via Artificial Intelligence and Machine Learning methods. The proposed framework combines such capabilities as data preprocessing, exploratory data analysis, dynamic visualization, prediction with the Random Forest algorithm, Explainable Artificial Intelligence (XAI), executive summaries provided by AI, business recommendations, conversational analytics, and PDF report generation in one system. With this combination of features, the system reduces the amount of manual work and the necessity of having different analytical tools independently.

According to the experimental results, the framework is capable of processing structured business data sets, performing the appropriate visualizations, providing predictions, and increasing the transparency of the models with the help of feature importance analysis. Also, the integration of the Google Gemini API allows for creating intelligent executive summaries and recommendations and

for using natural language, which makes the system applicable not only to technical but also non-technical people.

Acknowledgment

Finally, we would like to express our sincere thanks and appreciation to Mrs. Irshana Tabassum, Assistant Professor at the Department of Computer Science and Engineering, Lords Institute of Engineering and Technology, Hyderabad, for her valuable guidance and constant support. Moreover, the authors are grateful to the Department of Computer Science and Engineering, Lords Institute of Engineering and Technology, for all the resources provided during the research process

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