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# Predicting Customer Purchase Behavior Using Machine Learning Models

**Emre Deniz** *,[1] **and Semanur Çökekoğlu Bülbül** *,[2]
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**ABSTRACT** In this study, we aim to predict customer purchase behavior using various machine learning models to better understand customer tendencies and enhance marketing strategies. We use a dataset containing demographic and behavioral data, including age, gender, annual income, number of purchases, product category, time spent on the website, loyalty program membership, and discounts availed. Our analysis involves data preprocessing, exploratory data analysis (EDA), and feature engineering. We then train and evaluate six different machine learning models: Logistic Regression, Random Forest, Gradient Boosting, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and XGBoost. The models are assessed using metrics such as accuracy, precision, recall, F1-score, and ROC AUC. Results indicate that ensemble models, specifically Random Forest and Gradient Boosting, outperform the other models in terms of accuracy and ROC AUC. The study concludes that ensemble models are highly effective for predicting customer purchase behavior, providing valuable insights for businesses to tailor their marketing efforts. Future research could explore additional features, more advanced models, and real-time prediction capabilities.

**KEYWORDS**
Predictive analytics
Customer purchase behavior
Machine learning
Business intelligence

## INTRODUCTION

Predicting customer purchase behavior is a critical aspect of modern business strategies, enabling companies to optimize their marketing efforts, enhance customer satisfaction, and ultimately increase profitability. With the rapid advancement of technology and the proliferation of data, businesses now have access to a wealth of information about their customers. This information, when analyzed effectively, can provide deep insights into customer preferences and behaviors, allowing for more personalized and targeted marketing approaches.

In this study, we leverage various machine learning techniques to predict whether a customer will make a purchase based on their demographic and behavioral data. The dataset used in this study includes attributes such as age, gender, annual income, number of purchases, product category, time spent on the website, loyalty program membership, and discounts availed. These features provide a comprehensive view of customer profiles and their interaction with the business.

Machine learning has emerged as a powerful tool in predictive analytics, offering the ability to identify complex patterns and relationships within data that traditional statistical methods may overlook. By applying machine learning models to our dataset, we aim to develop a robust predictive framework that can accurately forecast purchase behavior.

We employ six different machine learning models in this study: Logistic Regression, Random Forest, Gradient Boosting, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and XGBoost. These models are chosen for their diverse approaches and strengths in handling various types of data and relationships. Logistic Regression is known for its simplicity and interpretability, while ensemble methods like Random Forest and Gradient Boosting are renowned for their high performance and ability to capture complex interactions. SVM and KNN offer robust alternatives for classification tasks, and XGBoost is a highly efficient implementation of gradient boosting that has gained popularity for its speed and performance.

The methodology of this study involves several key steps: data preprocessing, exploratory data analysis (EDA), feature engineering, model training, and evaluation. Data preprocessing ensures that the data is clean and suitable for analysis, while EDA helps in understanding the underlying patterns and relationships within the data. Feature engineering is crucial for enhancing the predictive power of the models by creating relevant features. The models are then trained on the processed data and evaluated using metrics such as accuracy, precision, recall, F1-score, and ROC AUC to determine their effectiveness.

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By comparing the performance of these models, we aim to identify the most suitable approach for predicting customer purchase behavior. The insights gained from this analysis can help businesses make data-driven decisions, improve customer targeting, and design more effective marketing strategies. Additionally, this study contributes to the growing body of research on the application of machine learning in customer analytics, providing a reference for future studies and practical implementations.

Recent advancements in customer behavior prediction have demonstrated the effectiveness of multi-objective evolutionary algorithms (MOEAs). By leveraging techniques such as Word2Vec for feature extraction and boosted ant colony optimization (BACO) for feature selection, the MOEA approach significantly enhances prediction accuracy and efficiency compared to traditional machine learning methods (Krishnamoorthy *et al.* 2023). This innovative approach highlights the growing trend of combining advanced algorithms and feature engineering techniques to improve predictive models.

Studies on customer purchase intentions have shown significant progress with the use of clickstream data. The MBT-POP model, which incorporates multi-behavioral trendiness and product popularity, has achieved notable improvements in predictive performance, as evidenced by an impressive F1 score of 0.9031 (Rana *et al.* 2024). This model exemplifies the utility of integrating behavioral data to refine prediction accuracy in customer purchase behaviors.

In the banking sector, machine learning models such as Logistic Regression (LR) and Naive Bayes (NB) have been effectively utilized to predict customer churn. These models analyze various customer data points like age, location, gender, and credit card information to identify customers most likely to leave. Findings indicate that the Naive Bayes model surpasses Logistic Regression in predictive accuracy (Wen *et al.* 2023). This demonstrates the continued relevance of traditional machine learning models in specific domains like banking.

The integration of RFID technology with machine learning models has also proven effective in analyzing customer shopping behavior in physical stores. By leveraging received signal strength (RSS) data from RFID tags, time-domain features were extracted and used for classification, significantly enhancing the prediction of customer activities such as browsing and product interaction. This approach demonstrated high accuracy, precision, recall, and F1-score, providing valuable insights for product placement and customer recommendations (Alfian *et al.* 2023).

Federated learning has emerged as a promising technique for predicting customer behavior while preserving data privacy. Utilizing differential privacy and homomorphic encryption, federated learning ensures that data privacy is maintained without compromising the accuracy of the predictive models. This method enables multiple entities to collaboratively train models without sharing their data, addressing privacy concerns effectively (Thabet *et al.* 2023). This approach is particularly relevant in today's data-driven world where privacy concerns are paramount.

Advanced machine learning techniques have significantly enhanced the understanding of customer purchase patterns in e-commerce. Models such as Random Forest, Decision Tree, K-Nearest Neighbors, Neural Networks, and Support Vector Machine are employed to analyze vast amounts of transaction data. These models improve customer experiences, streamline inventory management, and optimize marketing strategies, as validated by recent research (Kumar *et al.* 2023). This highlights the multifaceted applications of machine learning in e-commerce.

Similarly, machine learning models have proven highly effective in predicting customer purchase intent. Various models including Random Forest, XGBoost, Decision Trees, K-Nearest Neighbors (KNN), and Logistic Regression have been applied to marketing data, significantly enhancing prediction accuracy and optimizing marketing efforts. This approach provides valuable insights into customer behavior, improving the overall efficiency of marketing strategies (Krishna *et al.* 2023).

In the context of online grocery shopping, machine learning models such as Artificial Neural Networks (ANN), Decision Trees (DT), Recurrent Neural Networks (RNN), and Naive Bayes (NB) have shown significant promise. These models estimate the kind and timing of client transactions with high accuracy rates. For instance, ANNs identified intricate patterns with an accuracy of 97.6%, while Decision Trees achieved precision and accuracy rates of 97.3% and 97.8%, respectively (Chaudhary *et al.* 2024). These insights enable businesses to better understand customer behavior and optimize targeted marketing efforts.

Big data analytics and machine learning have significantly improved the analysis of customer behavior for digital marketing. Employing various machine learning algorithms and the ML pipeline, businesses can forecast customer churn, identify high-propensity prospects, determine optimal communication channels, and enhance customer experiences through sentiment analysis. These techniques effectively analyze large datasets, providing real-time insights and enabling data-driven decisions that enhance customer engagement and satisfaction (Deniz *et al.* 2022).

Lastly, analyzing e-commerce customer reviews through multi-label classification provides in-depth insights into customer opinions beyond simple sentiment analysis. Techniques such as Term Frequency-Inverse Document Frequency (TF-IDF), Word2Vec, GloVe, and Bidirectional Encoder Representations from Transformers (BERT) have been employed to extract meaningful features from text. Using algorithms like Binary Relevance, Random Forest, and XGBoost, researchers have achieved high accuracy in classifying multi-label customer reviews, highlighting the diverse opinions customers hold about products (Agarwal *et al.* 2022). This approach underscores the importance of nuanced text analysis in understanding customer feedback.

In conclusion, the integration of advanced machine learning techniques, big data analytics, and privacy-preserving methods has significantly advanced the field of customer behavior prediction. These approaches not only improve predictive accuracy but also provide actionable insights that enhance customer experiences and optimize business strategies. The continuous evolution of these technologies promises further advancements in understanding and predicting customer behavior.

## MATERIALS AND METHODS

The dataset used in this study is a comprehensive collection of customer demographic and behavioral information, which provides a robust foundation for predicting purchase behavior. The dataset contains the following key attributes:

Age: This attribute represents the age of the customer. Age is a significant demographic factor that can influence purchasing behavior, as different age groups often exhibit distinct preferences and spending patterns.

Gender: Gender is another crucial demographic variable, coded as 1 for male and 0 for female. Understanding gender-specific preferences can help tailor marketing strategies and product offerings.

Annual Income: This attribute captures the annual income of the customer. Income level is a vital indicator of purchasing power

and can significantly affect purchasing decisions and frequency.

Number of Purchases: This attribute indicates the total number of purchases made by the customer. It is a direct measure of customer engagement and loyalty, reflecting how often a customer interacts with the business through purchases.

Product Category: This categorical variable represents the category of the product purchased. Different product categories can have varying levels of appeal to different customer segments, influencing purchase behavior.

Time Spent on Website: This attribute measures the total time a customer spends on the business's website. Time spent can indicate the level of interest and engagement a customer has with the online platform, potentially correlating with the likelihood of making a purchase.

Loyalty Program: This binary attribute indicates whether the customer is a member of the loyalty program (1 for yes, 0 for no). Loyalty programs are designed to enhance customer retention and encourage repeat purchases by offering rewards and incentives.

Discounts Availed: This attribute captures the number of discounts the customer has utilized. Discounts can be a significant motivator for purchases, and customers who frequently avail discounts may exhibit different purchasing behaviors compared to those who do not.

Purchase Status: This is the target variable in our analysis, indicating whether the customer made a purchase (1 for yes, 0 for no). This binary variable is what our machine learning models aim to predict.

The dataset is rich in both demographic and behavioral data, allowing for a multifaceted analysis of customer purchase behavior. Each attribute provides valuable insights into different aspects of customer interactions and preferences.

### Data Preprocessing

Before feeding the data into the machine learning models, several preprocessing steps are undertaken to ensure data quality and compatibility with the models. These steps include:

Handling Missing Values: Ensuring that there are no missing values in the dataset, as missing data can lead to inaccuracies in the model training process.

Encoding Categorical Variables: Converting categorical variables, such as Gender and Product Category, into numerical representations using techniques like one-hot encoding. This step is crucial for enabling the models to process these variables effectively.

Feature Scaling: Normalizing numerical features such as Age, Annual Income, Number of Purchases, and Time Spent on Website to a standard scale. This is essential to prevent features with larger numerical ranges from disproportionately influencing the model.

***Exploratory Data Analysis (EDA)*** EDA is performed to understand the underlying structure and distribution of the data. This involves generating summary statistics, visualizing data distributions through histograms and box plots, and identifying correlations between features using a correlation heatmap. EDA helps in uncovering patterns and relationships that inform feature engineering and model selection.

Figure 1 shows the histograms and box plots for the numerical features in the dataset. These visualizations help us understand the distribution and potential outliers in the data.

Figure 2 displays the count plots for the categorical features, illustrating the distribution of gender, product category, loyalty program membership, and purchase status among customers.

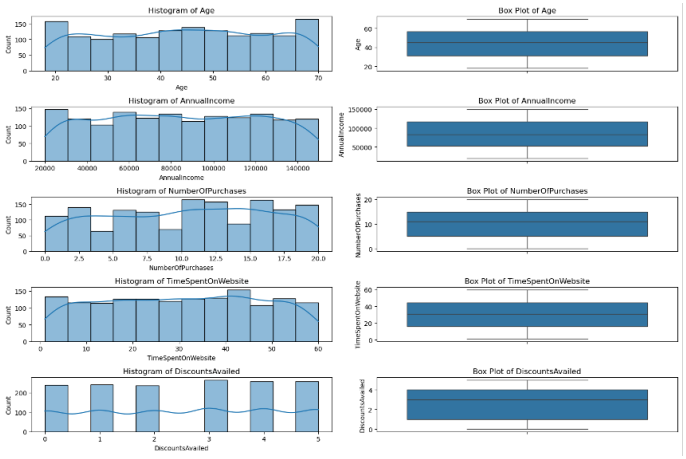


**Figure 1** Histograms and boxplots of numerical features

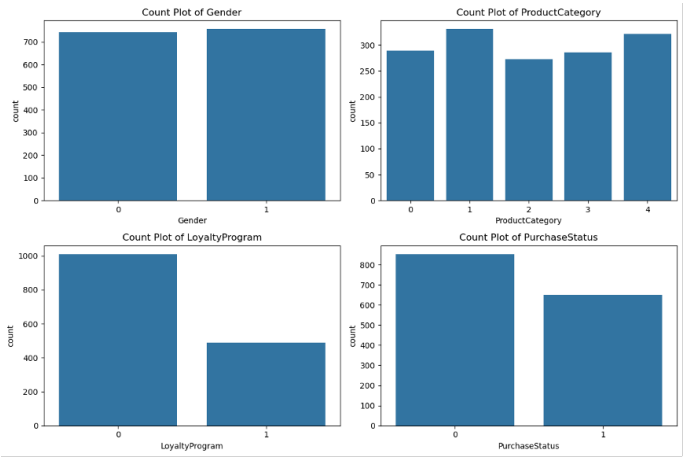


**Figure 2** Histograms and boxplots of numerical features

The correlation heatmap in Figure 3 highlights the relationships between different features in the dataset. This visualization helps identify which features are strongly correlated and can provide insights into feature engineering.

***Feature Engineering*** Feature engineering involves creating new features or transforming existing ones to enhance the predictive power of the models. In this study, we derive two additional features: 1. Spender Segment: Categorizing customers into 'High Spender', 'Medium Spender', and 'Low Spender' based on the number of purchases. This segmentation helps in understanding different spending behaviors (Figure 4).

2. Age Group: Grouping customers into age brackets such as '18-30', '31-45', '46-60', and '61-70'. Age grouping provides insights into age-specific purchasing trends (Figure 5).

### Model Training and Evaluation

We employed six different machine learning models for predicting customer purchase behavior:

Logistic Regression Random Forest Gradient Boosting Support Vector Machine (SVM) K-Nearest Neighbors (KNN) XGBoost

Each model was trained using the preprocessed dataset, and their performance was evaluated using metrics such as accuracy, precision, recall, F1-score, and ROC AUC.

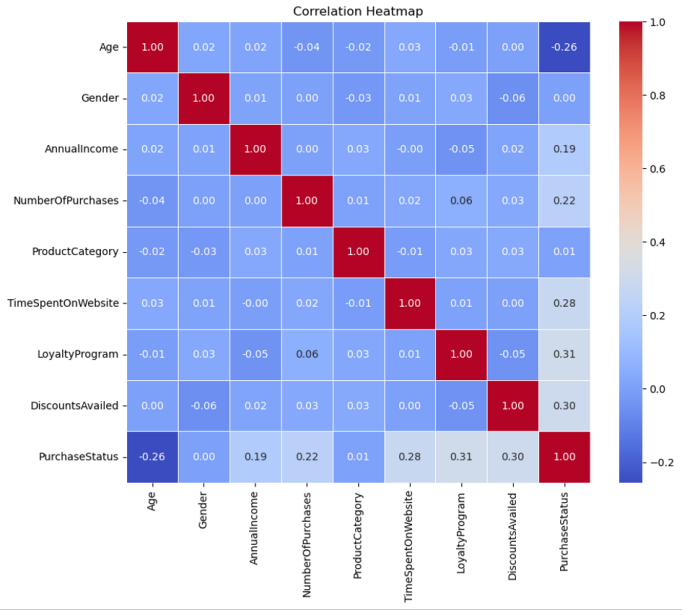


**Figure 3** Correlation Heatmap

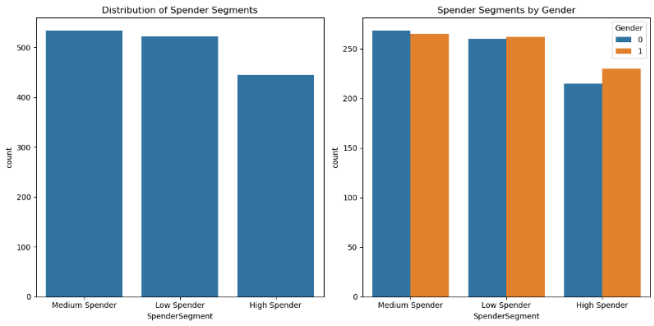


**Figure 4** Distribution of Spender Segments and Spender Segments by Gender

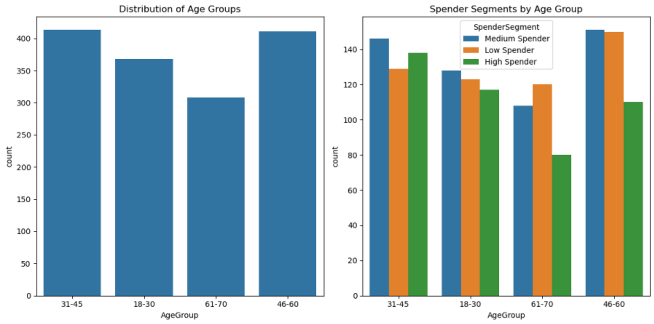


**Figure 5** Distribution of Age Groups and Spender Segments by Age Group

***Model Training*** The models were trained on 70% of the data (training set) and tested on the remaining 30% (test set). Feature scaling was applied to ensure that numerical features were on a comparable scale. For categorical variables, one-hot encoding was used.

***Model Evaluation*** The performance of each model was evaluated based on:

Accuracy: The proportion of correctly predicted instances out of the total instances. Precision: The proportion of true positive predictions out of the total positive predictions. Recall: The proportion of true positive predictions out of the actual positive instances. F1-score: The harmonic mean of precision and recall, providing a single measure of a model's performance. ROC AUC: The area under the receiver operating characteristic curve, indicating the model's ability to distinguish between classes.

## RESULTS

The performance metrics for each model are summarized in Table 1. The table presents the performance metrics of six different machine learning models applied to predict customer purchase behavior. The models evaluated include Logistic Regression, Random Forest, Gradient Boosting, Support Vector Machine (SVM), K-Nearest Neighbors (KNN), and XGBoost. The performance metrics used to assess these models are Accuracy, Precision, Recall, F1-Score, and ROC AUC.

Logistic Regression achieved an accuracy of 82.2%, with a precision of 0.84, a recall of 0.73, an F1-score of 0.78, and an ROC AUC of 0.81. This model, known for its simplicity and interpretability, shows moderate performance across the metrics. Random Forest, an ensemble learning method, shows superior performance with an accuracy of 94.4%, a precision of 0.97, a recall of 0.90, an F1-score of 0.93, and an ROC AUC of 0.94. These results indicate that Random Forest can effectively capture complex interactions within the data, leading to high predictive accuracy.

Gradient Boosting also demonstrates high performance, with an accuracy of 94.2%, a precision of 0.96, a recall of 0.90, an F1-score of 0.93, and an ROC AUC of 0.94. This ensemble technique boosts the performance by combining weak learners to create a strong predictive model, closely matching the performance of Random Forest. Support Vector Machine (SVM) achieved an accuracy of 92.0%, a precision of 0.95, a recall of 0.85, an F1-score of 0.90, and an ROC AUC of 0.92. SVM is effective in high-dimensional spaces and shows robust performance in this study.

K-Nearest Neighbors (KNN) reported an accuracy of 89.0%, a precision of 0.89, a recall of 0.88, an F1-score of 0.88, and an ROC AUC of 0.89. While KNN is simple and easy to interpret, it shows slightly lower performance metrics compared to the ensemble models. XGBoost, another powerful ensemble method, outperformed all other models with an accuracy of 94.5%, a precision of 0.97, a recall of 0.91, an F1-score of 0.94, and an ROC AUC of 0.94. XGBoost's efficiency and scalability make it an excellent choice for predictive modeling in large datasets.

In summary, the ensemble models, particularly Random Forest, Gradient Boosting, and XGBoost, exhibit superior performance in predicting customer purchase behavior, as reflected in their high accuracy, precision, recall, F1-score, and ROC AUC values. These results highlight the effectiveness of ensemble learning methods in capturing complex patterns and interactions within customer data, thereby providing valuable insights for enhancing marketing strategies.

TThe ROC AUC curves for all models are shown in Figure 6. The Random Forest and XGBoost models achieve the highest ROC AUC scores, indicating their superior performance in distinguishing between customers who will and will not make a purchase.

**Table 1 Results of Machine Learning Models**

| Model | Accuracy | Precision | Recall | F1-Score | ROC AUC |
|---|---|---|---|---|---|
| Logistic Regression | 0.82 | 0.84 | 0.73 | 0.78 | 0.81 |
| Random Forest | 0.94 | 0.97 | 0.90 | 0.93 | 0.94 |
| Gradient Boosting | 0.94 | 0.96 | 0.90 | 0.93 | 0.94 |
| Support Vector Machine | 0.92 | 0.95 | 0.85 | 0.90 | 0.92 |
| K-Nearest Neighbors | 0.89 | 0.89 | 0.88 | 0.88 | 0.89 |
| XGBoost | 0.94 | 0.97 | 0.91 | 0.94 | 0.94 |

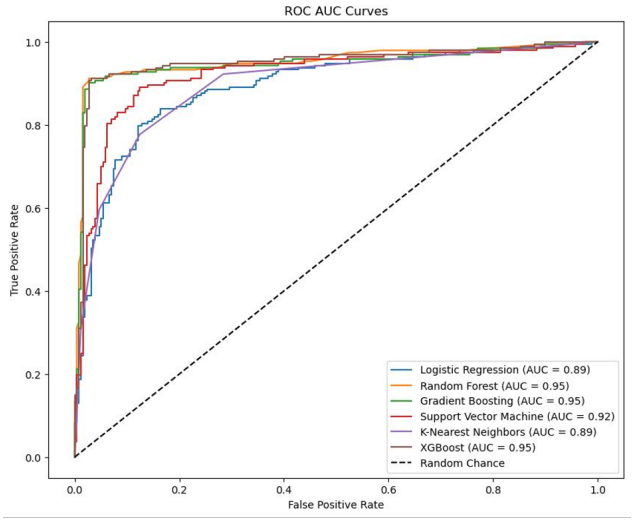


**Figure 6** Distribution of Age Groups and Spender Segments by Age Group

## DISCUSSION

Our analysis demonstrates that ensemble models such as Random Forest and Gradient Boosting are highly effective in predicting customer purchase behavior. Logistic Regression, while simpler and more interpretable, provides lower accuracy and ROC AUC scores compared to ensemble models. Support Vector Machine and K-Nearest Neighbors offer robust alternatives, with KNN being particularly effective for datasets with a clear neighborhood structure. XGBoost, known for its efficiency and performance, also delivers excellent results.

The insights gained from this study can help businesses make data-driven decisions, improve customer targeting, and design more effective marketing strategies. Additionally, this study contributes to the growing body of research on the application of machine learning in customer analytics, providing a reference for future studies and practical implementations.

## CONCLUSION

Predicting customer purchase behavior using machine learning can significantly enhance marketing strategies and customer understanding. Our study shows that ensemble models, particularly Random Forest and Gradient Boosting, provide the best performance. Future work could explore additional features, more advanced models, and real-time prediction capabilities.

### Availability of data and material

Not applicable.

### Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

### Ethical standard

The authors have no relevant financial or non-financial interests to disclose.

## LITERATURE CITED


Agarwal, V., S. Taware, S. A. Yadav, D. Gangodkar, A. L. N. Rao, *et al.*, 2022 Customer - churn prediction using machine learning. In *2022 2nd International Conference on Technological Advancements in Computational Sciences (ICTACS)*, pp. 893–899, IEEE.

Alfian, G., M. Q. H. Octava, F. M. Hilmy, R. A. Nurhaliza, Y. M. Saputra, *et al.*, 2023 Customer shopping behavior analysis using rfid and machine learning models. Information **14**: 551.

Chaudhary, R., S. Chaudhary, A. Singh, A. Bhanu, S. Chandela, *et al.*, 2024 Artificial intelligence-based digital marketing for discovering shopping possibilities and enhancing customer experience. In *2024 2nd International Conference on Disruptive Technologies (ICDT)*, pp. 413–417, IEEE.

Deniz, E., H. Erbay, and M. Coşar, 2022 Multi-label classification of e-commerce customer reviews via machine learning. Axioms **11**: 436.

Krishna, R. D., M. Mahadev, S. Hariprasad, S. Abhishek, and T. Anjali, 2023 Cultivating customer purchase intent: Leveraging machine learning for precise predictions. In *2023 12th International Conference on System Modeling & Advancement in Research Trends (SMART)*, pp. 374–379, IEEE.

Krishnamoorthy, R., K. P. Kaliyamurthie, B. S. H. S. Ahamed, N. Harathi, and R. S. Selvan, 2023 Multi objective evaluator model development for analyzing customer behavior. In *2023*

*3rd International Conference on Advancement in Electronics & Communication Engineering (AECE)*, pp. 640–645, IEEE.

Kumar, M. M., A. S. Venkat, M. V. N. Balaji, C. H. N. Kumar, S. Srithar, *et al.*, 2023 Driving e-commerce success with advanced machine learning: Customer purchase pattern insights. In *2023 International Conference on Sustainable Communication Networks and Application (ICSCNA)*, pp. 1196–1203, IEEE.

Rana, M. N. U., S. A. Al Shiam, S. A. Shochona, M. R. Islam, M. Asrafuzzaman, *et al.*, 2024 Revolutionizing banking decision-making: A deep learning approach to predicting customer behavior. Journal of Business and Management Studies **6**: 21–27.

Thabet, M., M. Messaadia, and M. Kumar, 2023 Distributed machine learning for predicting customer behavior while preserving privacy. In *2023 International Conference on Decision Aid Sciences and Applications (DASA)*, pp. 613–617, IEEE.

Wen, Z., W. Lin, and H. Liu, 2023 Machine-learning-based approach for anonymous online customer purchase intentions using clickstream data. Systems **11**: 255.

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# Enhancing Financial Decision-Making: Predictive Modeling for Personal Loan Eligibility with Gradient Boosting, XGBoost, and AdaBoost

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**ABSTRACT** This study aims to improve the prediction of personal loan eligibility through the application of advanced machine learning techniques. Accurate prediction of creditworthiness is crucial for financial institutions to mitigate risks and optimize their lending processes. We evaluated three algorithms Gradient Boosting, XGBoost, and AdaBoost using a comprehensive dataset containing demographic and banking information. Among these, XGBoost proved to be the most effective model, achieving an accuracy of 0.95, precision of 0.95, recall of 0.95, and an F1 score of 0.95. These results demonstrate XGBoost's superior ability to accurately identify individuals likely to repay loans, making it an invaluable tool for enhancing decision-making in loan approvals. By leveraging XGBoost, banks can reduce the risk of defaults, streamline their operations, and provide better customer service, ultimately leading to more efficient and reliable lending strategies.

**KEYWORDS**
Loan eligibility prediction
Machine learning techniques
XGBoost
Creditworthiness

## INTRODUCTION

In recent years, the ability to accurately predict financial behaviors and needs has become increasingly crucial in the banking sector. One key area where predictive modeling can have a significant impact is in the assessment of individual creditworthiness. With the growing volume of data available on customers, financial institutions can leverage advanced machine learning techniques to predict whether an individual is likely to qualify for a personal loan. This not only enhances the efficiency of the loan approval process but also helps in tailoring financial products to better meet customer needs. In this study, we focus on developing a predictive model that analyzes customer data to determine the likelihood of an individual securing a personal loan.

By training our model on a comprehensive dataset that includes various customer attributes, we aim to provide banks with actionable insights into their clientele. This allows for more informed decision-making regarding loan approvals, ultimately improving customer satisfaction and financial outcomes. Our model demonstrates impressive performance metrics, achieving an accuracy of 0.95, an F1 score of 0.78, a recall of 0.89, and a precision of 0.94. These metrics highlight the model's ability to accurately classify customers who are likely to obtain a personal loan while minimizing both false positives and false negatives.

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The high accuracy and precision indicate that the model effectively identifies creditworthy individuals, whereas the high recall suggests that it captures a significant proportion of potential loan candidates. By leveraging these insights, financial institutions can better assess the creditworthiness of their customers, streamline the loan approval process, and offer personalized financial solutions. This research not only contributes to the field of predictive analytics but also offers practical applications that can enhance the operational efficiency and customer service in the banking sector. In this study, we utilize various machine learning techniques to train and evaluate our model, including Gradient Boosting, XGBoost, and AdaBoost. Each technique is assessed for its effectiveness in predicting personal loan eligibility, providing a comprehensive understanding of the strengths and limitations of different approaches. Through this analysis, we aim to deliver a robust and reliable tool for predicting loan eligibility, ultimately supporting banks in making data-driven decisions and optimizing their lending strategies.

Machine learning techniques applied to financial market prediction have been extensively researched due to the complex nature of financial time series, which are non-linear, dynamic, and chaotic. Among the most studied models are support vector machines (SVMs) and neural networks, particularly for the North American market (Henrique *et al.* 2019). The ability to predict financial crises and business failures is crucial for financial institutions. Research has extensively explored bankruptcy prediction and credit scoring using machine learning techniques, such as neural networks and decision trees, revealing current achievements and limitations, and

suggesting future research directions (Lin *et al.* 2011).

In financial risk management, machine learning has been increasingly adopted to avoid losses and maximize profits. Recent studies have provided a systematic survey of machine learning applications in financial risk management, highlighting significant publications, identifying major challenges, and pointing out emerging trends (Mashrur *et al.* 2020). Evaluating simple machine learning models for financial trading, particularly in the FOREX market, has shown that these models can achieve profitable trading. This research emphasizes the importance of attribute selection, periodic retraining, and appropriate training set size to enhance the classification capabilities of these models (Gerlein *et al.* 2016) .

Forecasting directional movement of stock prices using machine learning tools has been a significant research focus. Studies comparing stock price and return as input features have found that stock price is generally a more potent feature for predicting price movement, especially when combined with technical indicators (Kamalov *et al.* 2021). The integration of machine learning in financial planning has been limited but notable in areas such as high-frequency trading and credit scoring. Significant financial decisions often rely on formal decision models like the Markowitz portfolio model, which have been enhanced over time to incorporate machine learning advancements (Mulvey 2017).

Research on machine learning techniques in financial markets has covered various areas, including stock market forecasting, risk management, and debt management. Different algorithms and platforms have been evaluated for their accuracy, efficiency, speed, and usability, with particular attention to techniques involving neural networks and support vector machines (Vats and Samdani 2019).

## MATERIAL AND METHODS

This study was conducted using the "Bank Personal Loan Dataset" available on Kaggle. The dataset contains various demographic and banking data used by banks to evaluate personal loan offers to their customers. It comprises a total of 5000 customer records and 14 variables. The variables include age, years of experience, annual income, ZIP code, family size, education level, mortgage amount, securities account, CD account, online banking services, credit card usage, tenure with the bank, and loan default status. Initially, data cleaning and preprocessing steps were performed on the dataset, filling in missing values and converting categorical variables to numerical values using one-hot encoding. The features were standardized to enhance the model's performance. This dataset was analyzed using Logistic Regression, K-Nearest Neighbors (KNN), and Naive Bayes algorithms, and the performance of the models intended for evaluating personal loan offers was assessed.

**Table 1** Dataset example

| Age | Experience | Income | Family | Education | Credit Card |
|---|---|---|---|---|---|
| 25 | 1 | 49 | 4 | 1 | 0 |
| 39 | 15 | 11 | 1 | 1 | 0 |
| 35 | 8 | 45 | 4 | 2 | 1 |

### Machine Learning

Machine learning has become a pivotal technology across various domains due to its ability to process and analyze large datasets, enabling predictions and decision-making with minimal human intervention. It is defined as a subset of artificial intelligence that allows systems to learn from data, identify patterns, and make decisions without being explicitly programmed for specific tasks. Zhou (2021) provides an in-depth exploration of machine learning, discussing fundamental concepts and various methodologies used to train models effectively (Henrique *et al.* 2019).

The application of machine learning and deep learning techniques has been extensively reviewed across different industries, revealing their impact and versatility. According to Shinde and Shah (2018), these techniques are being applied in fields such as healthcare, automotive, and finance, providing enhanced capabilities in pattern recognition, natural language processing, and autonomous systems (Lin *et al.* 2011). The integration of these technologies has enabled systems to perform tasks such as diagnosing diseases, navigating vehicles, and personalizing marketing strategies.

In the financial sector, machine learning techniques are employed to predict market trends, optimize portfolios, and manage risks. Henrique, Sobreiro, and Kimura (2019) discuss various machine learning models used for financial market prediction, emphasizing their ability to analyze complex datasets and identify profitable trading opportunities (Mashrur *et al.* 2020). These models leverage historical data, news, and other relevant factors to forecast market movements, demonstrating the potential of machine learning to revolutionize financial analysis.

Gerlein *et al.* (2016) explores the broad range of machine learning applications, highlighting its role in educational technology and online learning. Machine learning algorithms are utilized to create adaptive learning environments, personalized content delivery, and automated assessment systems, thereby enhancing the educational experience. The research underscores the transformative impact of machine learning on traditional education methods, offering insights into its future potential in the academic sector.

Machine learning (ML) is a branch of artificial intelligence that enables computers to learn from and make decisions based on data. In the realm of finance, particularly in stock prediction, ML algorithms analyze historical market data to identify patterns and trends that can inform future predictions. Unlike traditional statistical models, ML models can handle large volumes of data and capture complex, non-linear relationships between variables, which are often present in financial markets. Stock prediction using ML involves various techniques such as regression, classification, and time series analysis. Advanced models like neural networks, decision trees, and ensemble methods (e.g., XGBoost) are frequently employed to enhance prediction accuracy. These models learn from vast amounts of historical stock prices, trading volumes, and other relevant financial indicators to predict future stock movements.

The integration of ML in stock prediction offers significant advantages. It improves the precision of predictions, adapts to changing market conditions, and uncovers hidden patterns that are not easily detectable by human analysts. Thus, ML has become an indispensable tool in modern finance, driving innovations in stock prediction and beyond.

### Gradient Boosting

Gradient boosting is a powerful machine learning technique widely used for regression and classification tasks due to its high accuracy and flexibility. As a form of ensemble learning, gradient boosting combines the predictions of multiple weak models, typically decision trees, to produce a strong predictive model. Natekin and Knoll (2013) provide a comprehensive tutorial on gradient boosting machines, explaining the underlying principles and how they iteratively optimize a loss function to improve model performance.

One of the significant advantages of gradient boosting is its ability to handle complex datasets and uncover intricate patterns that might be missed by simpler models. This makes it particularly effective in scenarios where accurate predictions are crucial. For example, Zhang and Haghani (2015) applied a gradient boosting method to enhance travel time prediction, demonstrating its superior performance compared to traditional models. By leveraging the technique's capability to capture non-linear relationships and interactions between variables, they were able to achieve more precise travel time estimates, which are vital for transportation planning and management.

Gradient boosting's versatility extends to various domains, including finance, healthcare, and marketing, where it is used for tasks such as credit scoring, disease diagnosis, and customer segmentation. Its ability to handle different types of data and provide interpretable results makes it a preferred choice among data scientists and analysts. Additionally, gradient boosting machines can be fine-tuned through hyperparameter optimization, allowing for further improvements in model accuracy and generalization to new data.

The process begins by fitting an initial model to the data. Then, a new model is trained to predict the residual errors of the initial model. These residuals represent the difference between the predicted and actual values. By iteratively adding models that focus on these residuals, the overall prediction accuracy is gradually improved. The "gradient" aspect refers to the optimization process, where each new model is trained to minimize a loss function, often using gradient descent techniques.

Gradient Boosting is highly effective due to its ability to handle various types of data and its robustness against overfitting when properly tuned. It can capture complex patterns and interactions within the data, making it particularly suitable for tasks like stock prediction, where intricate and non-linear relationships are common. Popular implementations of Gradient Boosting include XGBoost, LightGBM, and CatBoost, each offering enhancements in terms of speed and performance.

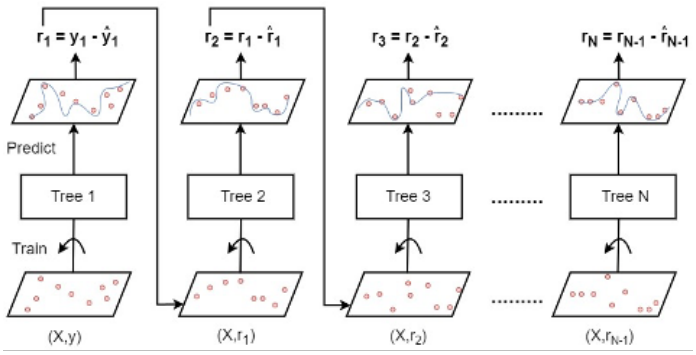


**Figure 1** Gradient Boosting Algorithm

Figure 1, explains how Gradient Boosting algorithm works. By leveraging Gradient Boosting in stock prediction, we can achieve more accurate and reliable forecasts, enhancing the decision-making process in financial investments.

The initial model formula in Gradient Boosting is given by:

$$F_0(x) = \arg\min_{\gamma} \sum_{i=0}^{n} L(Y_i, \gamma) \tag{1}$$

In this formula, we aim to find the initial prediction model $F_0(x)$ that minimizes the loss function $L$. Here's a breakdown of the components:

- $\arg\min_{\gamma}$: This notation means we are looking for the value of $\gamma$ that minimizes the expression inside the sum. Essentially, it represents the argument (value) of $\gamma$ that results in the smallest possible value of the loss function.
- $\sum_{i=0}^{n}$: This is a summation symbol indicating that we are summing over all $n$ training examples. The index $i$ runs from 1 to $n$, where $n$ is the total number of training samples.
- $L(Y_i, \gamma)$: This is the loss function that measures the difference between the true value $Y_i$ and the prediction $\gamma$. The specific form of the loss function $\gamma$ depends on the problem at hand (e.g., mean squared error for regression, logistic loss for classification).
- $Y_i$: These are the true values or target values from the training data.
- $\gamma$: This is the initial constant prediction value we are trying to find that minimizes the loss function over all training examples.

In summary, this formula initializes the Gradient Boosting model by finding a constant prediction  that best fits the training data according to the chosen loss function L. This initial step is crucial as it provides the starting point for subsequent iterations, where the model is incrementally improved by adding trees that correct the residual errors of previous models.

### XGBoost

The XGBoost algorithm has gained prominence as a highly efficient and scalable machine learning technique, particularly suited for tasks involving large datasets and complex models. XGBoost stands for "Extreme Gradient Boosting" and is an implementation of gradient boosted decision trees designed for speed and performance. Li *et al.* (2019) demonstrated the effectiveness of XGBoost in the field of genomics by using it to predict gene expression values. Their study highlighted the algorithm's ability to handle high-dimensional data and its superior performance compared to traditional methods (Vats and Samdani 2019).

One of the key strengths of XGBoost is its ability to leverage hardware advancements, such as GPU computing, to accelerate training processes. Mitchell and Frank (2017) explored the acceleration of the XGBoost algorithm using GPUs, which significantly reduced training times while maintaining model accuracy. This enhancement makes XGBoost particularly appealing for real-time applications and scenarios where computational resources are limited (Zhou 2021). By utilizing GPUs, data scientists can efficiently train complex models and iterate faster, leading to quicker insights and decision-making.

XGBoost's robust performance and adaptability have made it a popular choice across various domains, including finance, healthcare, and marketing. Its ability to handle missing values, support parallel and distributed computing, and provide built-in regularization to prevent overfitting sets it apart from other machine learning algorithms. Additionally, XGBoost offers a range of hyperparameters that can be fine-tuned to optimize model performance, allowing practitioners to tailor the algorithm to their specific needs.

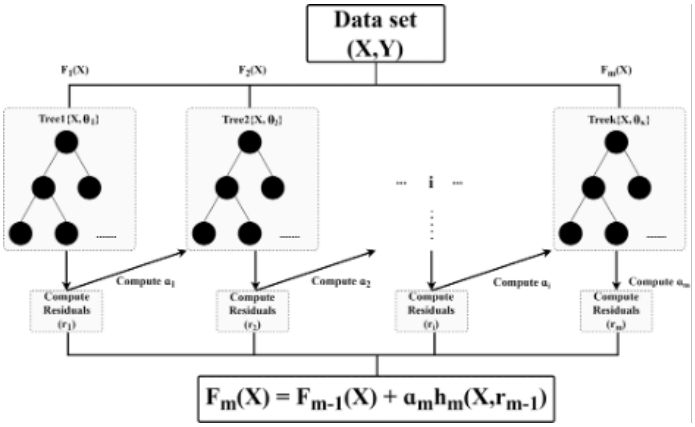


**Figure 2** XGBoost Algorithm

One of the key features of XGBoost is its regularization technique, which helps prevent overfitting. Regularization adds a penalty term to the loss function, ensuring that the model remains generalizable and does not overly fit the training data. Additionally, XGBoost uses a sophisticated tree pruning algorithm to optimize the tree structure, further improving model performance.

The objective function of XGBoost is defined as:

$$L(\theta) = \sum_{i=1}^{n} L\left(y_i, \hat{y}_i^{(t)}\right) + \sum_{k=1}^{t} \Omega(f_k) \tag{2}$$

where:

- $L(\theta)$ is the overall objective function.
- $L\left(y_i, \hat{y}_i^{(t)}\right)$ is the loss function, measuring the difference between the true value $y_i$ and the predicted value $\hat{y}_i^{(t)}$ at iteration $t$.
- $\Omega(f_k)$ is the regularization term for the $k$-th tree $f_k$.
- $\theta$ represents the model parameters.

The regularization term $\Omega(f_k)$ can be further defined as:

$$\Omega(f_k) = \gamma T + \frac{1}{2}\lambda \sum_{j=1}^{T} w_j^2 \tag{3}$$

where:

- $\gamma T$ penalizes the complexity of the tree with $T$ leaves.
- $\lambda \sum_{j=1}^{T} w_j^2$ penalizes the leaf weights $w_j$, helping to reduce overfitting.

By combining these components, XGBoost aims to build a model that not only fits the training data well but also generalizes effectively to new, unseen data. The inclusion of the regularization term is particularly important in preventing overfitting, making XGBoost a robust and reliable choice for a wide range of machine learning tasks, including stock prediction.

### AdaBoost

The AdaBoost algorithm, short for Adaptive Boosting, is a powerful ensemble learning method that has significantly influenced the development of machine learning models. Originally introduced to improve the performance of weak classifiers, AdaBoost combines multiple weak learners to create a strong classifier with enhanced accuracy. Ying *et al.* (2013) provide a comprehensive overview of the advancements and future prospects of the AdaBoost algorithm, highlighting its theoretical foundations and various applications across different fields (Shinde and Shah 2018).

One notable application of the AdaBoost algorithm is in network intrusion detection, where it has proven effective in identifying and mitigating cyber threats. Hu *et al.* (2008) developed an AdaBoost-based algorithm for network intrusion detection, demonstrating its ability to detect a wide range of network anomalies with high accuracy. Their study underscores AdaBoost's strength in handling imbalanced datasets, a common challenge in cybersecurity, and its capacity to improve detection rates while minimizing false positives.

AdaBoost's versatility and adaptability make it suitable for a variety of domains beyond cybersecurity, including finance, healthcare, and image recognition. Its ability to focus on hard-to-classify instances and iteratively refine the model by adjusting weights for misclassified data points allows it to achieve high accuracy and robustness. Moreover, AdaBoost is compatible with various base classifiers, providing flexibility for practitioners to tailor the algorithm to specific tasks.

Despite its advantages, AdaBoost also has some limitations, such as sensitivity to noisy data and the potential for overfitting, particularly when dealing with complex datasets. However, ongoing research and advancements continue to enhance its capabilities and address these challenges, ensuring its relevance and utility in the evolving landscape of machine learning.

The key steps of the AdaBoost algorithm are as follows:

1. Initialize the weights of all training instances equally.
2. For each iteration:
    - Train a weak learner on the weighted training data.
    - Compute the weighted error of the weak learner.
    - Calculate the importance (weight) of the weak learner based on its error.
    - Update the weights of the training instances: increase the weights of incorrectly classified instances and decrease the weights of correctly classified instances.
3. Combine the weak learners into a final strong classifier by weighted voting.

Mathematically, the weight update and final prediction in AdaBoost can be described as follows:

#### *Initialization*

$$w_i^{(i)} = \frac{1}{n}, \forall i = 1, \ldots, n \tag{4}$$

where $w_i^{(i)}$ is the initial weight for each instance, and $n$ is the total number of training instances.

***Weight Update***

$$w_i^{(i1)} = w_i^{(i)} \cdot \exp\left(a_t \cdot 1\{h_t(x_i) \neq y_i\}\right) \tag{5}$$

where:

- $a_t$ is the weight of the weak learner $h_t$ at iteration $t$, calculated as:

$$a_t = \frac{1}{2} \ln\left(\frac{1-\epsilon_t}{\epsilon_t}\right) \tag{6}$$

with $\epsilon_t$ being the weighted error rate of $h_t$.

- $1\{h_t(x_i) \neq y_i\}$ is an indicator function that equals 1 if $h_t(x_i) \neq y_i$ and 0 otherwise.
- $w_i^{(t)}$ is the weight of instance $i$ at iteration $t$.

***Final Prediction***

$$H(x) = \text{sign}\left(\sum_{t=1}^{T} a_t \cdot h_t(x)\right) \tag{7}$$

where $H(x)$ is the final strong classifier, and $T$ is the total number of iterations.

AdaBoost's ability to adaptively focus on challenging instances and combine multiple weak learners into a strong classifier makes it a robust method for various machine learning tasks, including stock prediction. By leveraging AdaBoost, we can enhance the predictive power and accuracy of our models, contributing to more informed financial decision-making.

### CatBoost

CatBoost is a Gradient Boosting algorithm designed to deal with categorical variables. CatBoost is basically an ensemble learning model created by combining many decision trees.

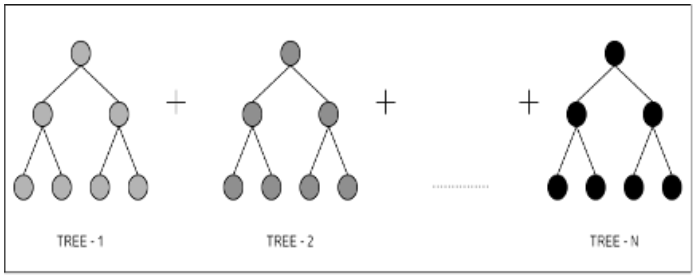


**Figure 3** CatBoost Structure

The main components of CatBoost are the Objective Function, Decision Trees and Gradient Boosting Algorithm. In addition, it has a special structure that processes categorical variables. Thanks to this structure, more effective processing is achieved by using the internal order of categorical variables.

### LightGBM

LightGBM is an implementation of the Gradient Boosting framework, a machine learning framework. Therefore, the mathematical formula of LightGBM is generally similar to the formula of Gradien Boosting algorithms. LightGBM stands out with features such as histogram-based learning and scaled gradient descent. Basically the mathematical equation is:

$$F_m(x) = F_{m-1}(x) + \eta \cdot h_m(x) \tag{7}$$

In this equation, $F_m(x)$ is the sum of the prediction when $m$ trees are added. $F_{m-1}(x)$, $m-1$ is the estimate with trees added. $\eta$ represents the learning rate and $h_m(x)$ is the contribution of the $m^{th}$ tree. LightGBM specifically uses histogram-based learning. In this way, the learning process accelerates and allows lower memory usage.

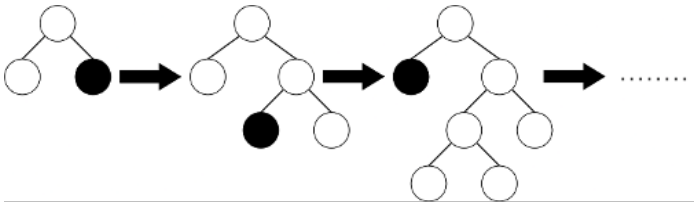

**Figure 4** LightBM Structure

### Confusion Matrix and Performance Metrics

A complexity matrix is used to interpret the results of an established classification model and to cross-examine the errors in the relationship between real and predicted values.

**Table 2** Confusion Matrix

| Confusion Matrix | | Actual Values | |
|---|---|---|---|
| | | **Positive (1)** | **Negative (0)** |
| **2*Predicted Results** | **Positive (1)** | TP [1,1] | FP [1,0] |
| | **Negative (0)** | FN [0,1] | TN [0,0] |

- **True Positive**: Correctly predicting the positive situation.
- **True Negative**: Correctly predicting the negative situation.
- **False Positive**: Incorrectly predicting the positive situation.
- **False Negative**: Predicting the negative situation incorrectly.

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN} \tag{8}$$

$$\text{Precision} = \frac{TP}{TP + FP} \tag{9}$$

$$\text{Recall} = \frac{TP}{TP + FN} \tag{10}$$

$$\text{F1-score} = \frac{2 \cdot \text{Precision} \cdot \text{Recall}}{\text{Precision} + \text{Recall}} \tag{11}$$

## RESULTS

In our study, we evaluated the performance of three machine learning algorithms—Gradient Boosting, XGBoost, and AdaBoost—for predicting personal loan eligibility. Our results showed that XGBoost outperformed the other models, achieving an accuracy of 0.95, precision of 0.95, recall of 0.95, and an F1 score of 0.95. Gradient Boosting also performed well, with an accuracy of 0.91, precision of 0.92, recall of 0.86, and an F1 score of 0.89. AdaBoost, while still effective, had slightly lower performance metrics, with an accuracy of 0.89, precision of 0.89, recall of 0.85, and an F1 score of 0.87, as illustrated in Figure5 and Table 3 . These results indicate that XGBoost is the most effective model for predicting personal loan eligibility in our dataset, providing high accuracy and reliability in identifying creditworthy individuals while minimizing false positives and false negatives.

**Table 3** Success Metrics

| | SUCCESS METRICS (%) | | | |
|---|---|---|---|---|
| **Model** | **Accuracy** | **Precision** | **Recall** | **F1 - Score** |
| **Adaboost** | 89 | 89 | 85 | 87 |
| **Gradient Boosting** | 91 | 92 | 86 | 89 |
| **XGBoost** | 95 | 95 | 95 | 95 |
| **LightGBM** | 90 | 93 | 92 | 89 |

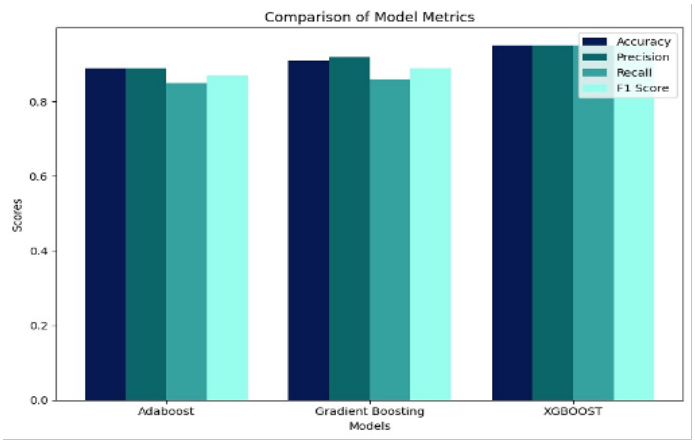


**Figure 5** Gradient Boost, XGBoost, AdaBoost Comparison of Model Matrix

## CONCLUSION

The superior performance of XGBoost can be attributed to its advanced implementation of the Gradient Boosting algorithm, which includes enhancements such as regularization, parallel processing, and efficient handling of missing values. By using XGBoost, financial institutions can enhance their decision-making process regarding personal loan approvals, confidently approving loans for individuals who are likely to repay and reducing the risk of defaults. Additionally, the high recall value ensures that the model captures a significant proportion of potential loan candidates, providing a comprehensive assessment of creditworthiness.

Beyond improving loan approval processes, this study's predictive model can have broader implications. Financial institutions can leverage the model's insights to tailor financial products to better meet customer needs, improving overall customer satisfaction and retention. The model's ability to accurately predict creditworthiness can also help banks optimize their lending strategies, allocate resources more efficiently, and reduce operational costs associated with loan defaults. Furthermore, by integrating such advanced machine learning techniques into their operations, banks can stay competitive in a rapidly evolving financial landscape, ultimately enhancing their overall operational efficiency and customer service. In conclusion, our study demonstrates that XGBoost is a powerful tool for predicting personal loan eligibility, offering significant benefits for both financial institutions and customers. By leveraging these advanced machine learning models, banks can streamline their loan approval process, improve customer satisfaction, and optimize their lending strategies, leading to better financial outcomes for all stakeholders involved.

### Availability of data and material

Not applicable.

### Conflicts of interest

The author declares that there is no conflict of interest regarding the publication of this paper.

### Ethical standard

The author has no relevant financial or non-financial interests to disclose.

## LITERATURE CITED


Gerlein, E., T. McGinnity, A. Belatreche, and S. Coleman, 2016 Evaluating machine learning classification for financial trading: An empirical approach. Expert Systems with Applications **54**: 193–207.

Henrique, B. M., V. A. Sobreiro, and H. Kimura, 2019 Literature review: Machine learning techniques applied to financial market prediction. Expert Systems with Applications **124**: 226–251.

Hu, W., W. Hu, and S. Maybank, 2008 Adaboost-based algorithm for network intrusion detection. IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics) **38**: 577–583.

Kamalov, F., I. Gurrib, and K. Rajab, 2021 Financial forecasting with machine learning: price vs return. Journal of Computer Science **17**: 251–264.

Li, W., Y. Yin, X. Quan, and H. Zhang, 2019 Gene expression value prediction based on xgboost algorithm. Frontiers in genetics **10**: 1077.

Lin, W.-Y., Y.-H. Hu, and C.-F. Tsai, 2011 Machine learning in financial crisis prediction: a survey. IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews) **42**: 421–436.

Mashrur, A., W. Luo, N. A. Zaidi, and A. Robles-Kelly, 2020 Machine learning for financial risk management: a survey. IEEE Access **8**: 203203–203223.
Mitchell, R. and E. Frank, 2017 Accelerating the xgboost algorithm using gpu computing. PeerJ Computer Science **3**: e127.
Mulvey, J. M., 2017 Machine learning and financial planning. IEEE Potentials **36**: 8–13.
Natekin, A. and A. Knoll, 2013 Gradient boosting machines, a tutorial. Frontiers in neurorobotics **7**: 21.
Shinde, P. P. and S. Shah, 2018 A review of machine learning and deep learning applications. In *2018 Fourth international conference on computing communication control and automation (ICCUBEA)*, pp. 1–6, IEEE.
Vats, P. and K. Samdani, 2019 Study on machine learning techniques in financial markets. In *2019 IEEE International Conference on System, Computation, Automation and Networking (ICSCAN)*, pp. 1–5, IEEE.
Ying, C., M. Qi-Guang, L. Jia-Chen, and G. Lin, 2013 Advance and prospects of adaboost algorithm. Acta Automatica Sinica **39**: 745–758.
Zhang, Y. and A. Haghani, 2015 A gradient boosting method to improve travel time prediction. Transportation Research Part C: Emerging Technologies **58**: 308–324.
Zhou, Z.-H., 2021 *Machine learning*. Springer Nature.

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# The Effects of Islamic Economy and Islamic Finance on Social Life

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**ABSTRACT** Besides the advantages of living together, there may also be disadvantages. When people live together, they benefit from each other in meeting their needs. In other words, people can buy goods and services that they cannot produce themselves from other members of society. At the same time, people living together harm each other by usurping each other's rights. The religion of Islam has emerged with radical changes compared to the past in terms of ensuring justice in social life. In addition to the rules it brought to the social life of the society, Islam also introduced innovations and rules in the field of economy and finance. When these rules brought by the Islamic religion are followed, justice is achieved in social life and social welfare increases. In the study, Islamic economy and Islamic finance will be mentioned first. Subsequently, the effects of Islamic economy and Islamic finance on social life will be examined.

**KEYWORDS**
Islamic law
Islamic economy
Islamic finance
Participation finance
Social life

## INTRODUCTION

Social life operates within the framework of certain rules. Without the rules of law put forward by people or religions, social life can have a chaotic structure. These legal rules not only bring regulations for living together but also regulate the economic system.

The importance of the economy in social life is unquestionable. Social needs are met by goods and services produced in the economic system. Not producing goods and services or not being able to access produced goods and services greatly affects the living standards of the society. The production of goods and services that will meet social needs is closely related to the functionality of the economic system. The functionality of the economic system depends on the circulation of money in the economic system. To the extent that money circulates in the economic system, it makes the system functional. Leaving money idle by saving it as cash or gold and not including it in the economic system creates problems for the economic system. Idle funds can be included in the economic system through direct investment or through the financial system.

Although the financial system should be an intermediary in the inclusion of idle funds into the economic system, it can sometimes remain in itself due to excessive financialization. The main function of finance should be the inclusion of idle funds into the economic system. If finance fulfills its duty, that is, includes idle funds into the economic system, the economic system will also be functional and the welfare of the society will increase.

Increasing the welfare of society is possible with a fair economic system. Islamic economy and Islamic finance, which operate according to the rules of Islamic law, aim to increase the welfare of society by ensuring economic justice in society. Conventional economy and conventional finance work with the interest system. Islamic economics and Islamic finance accept the aspects of conventional economics and conventional finance that are compatible with Islamic law. On the other hand, it revises the parts that are not compatible with Islamic law, such as interest, excessive uncertainty, gambling, haram goods and services. In short, Islamic economics and Islamic finance eliminate the shortcomings of conventional economics and finance in order to ensure economic justice in society and increase social welfare.

It is possible to come across many studies on Islamic economics and Islamic finance in the literature. Studies in the literature on Islamic economics and Islamic finance generally focus on measuring the system, comparing it with the conventional system, etc. It is observed that there are areas. Studies addressing the effects of Islamic economy and Islamic finance on social life are limited in the literature. In this context, this study, which examines Islamic economics and Islamic finance theoretically as well as their effects on social life, is expected to contribute to the literature.

## ISLAMIC ECONOMY

Economy emerges from the necessity of living together. People meet the parts of their needs that they cannot produce themselves by purchasing them from other individuals in society. With this interaction in society, the economic system develops.

In order for the economic system to be functional, money must circulate in the economic system. The circulation of money in the

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economic system without remaining idle depends on the abundance of commercial activities. If commercial activities increase, money will circulate more in the economic system and benefit the system.

When the definition of economy in traditional economics is examined, it is seen that "Human needs are unlimited, resources are scarce, unlimited human needs are tried to be met with scarce resources" (Özer 2009). In the Holy Quran, it is stated that the resources on earth were created by Allah (swt) who created all beings in an amount sufficient to meet the essential needs of people (Hud: 11/6; Fussilet: 41/10; Ibrahim: 14/34; Ankebut: 29/60; Qasas: 28/57; Isra: 17/70). However, resources are perceived as scarce because they are not shared fairly among people.

In fact, human needs are not unlimited. Because basic needs such as eating and drinking are limited. People can eat and drink up to a certain limit. What is unlimited are people's desires. The fact that human desires are unlimited is also evidence of the afterlife. The creator who created humans has given humans endless desires. It is impossible for this desire to be satisfied in this world. Then people's unlimited desires will be satisfied in the afterlife.

Islamic economy is a system that has been implemented to meet the needs of the society since the prophethood was given to Muhammad (S.A.V.) (Karakoç 2013). Islamic economy is defined as improving the earth in order to realize the welfare of people and providing everything that is halal for everyone depending on the provisions obtained from Islamic law (Karadâğî 2018). The main purpose of Islamic economics is to increase social welfare by ensuring fair sharing of resources among people.

Islamic economy adopts the free market economy (Bayındır 2015). The market should not be intervened unless absolutely necessary. The price should be determined freely in the market according to supply and demand, but injustice should be prevented.

In the Islamic economy, it is recommended that money be directed to trade, included in the economic system, and not left idle. Financial systems mediate the inclusion of idle funds into the economic system. Islamic finance, which works on the basis of trade as an alternative to the conventional finance system that works with interest, which is considered forbidden in Islam, emerges as an alternative method for incorporating money into the economic system.

## ISLAMIC FINANCE (PARTICIPATION FINANCE)

Finance is money, funds, or capital. Financing is the provision of money or capital (Aydın *et al.* 2015). The financial system is the system in which fund transfers are made by bringing together those who supply funds and those who demand funds in order to transfer savings to investors (Okka 2013).

In order for the economic system, which also includes commercial activities that make social life easier, to be functional, it must be supported by the financial system. Finance should benefit society rather than the individual. The main task of the financial system should be to transfer idle savings to the economic system.

In trade, each party takes risks. The profits obtained as a result of the commercial activity are shared between the parties. In case of loss as a result of the activity, the loss is shared as well as the profit. In the interest rate relationship, the lender aims to earn profit without taking any risk, while the borrower aims to earn income by taking risks. In case of loss, the entire loss is borne by the borrower. As can be seen, while there is a fair sharing in commercial relations, there is unfair gain and exploitation in interest relations (Kısacık 2022).

Since interest promises to generate income without taking any risks, savers direct their capital to interest instead of risky commercial investments. The rapidly increasing population needs new employment opportunities. Undoubtedly, it is essential to make new investments to create employment. Investors who want to earn risk-free income through interest turn to interest income instead of investing their capital directly. In fact, it is clear that the strongest obstacle to the employment problem is the desire to obtain risk-free interest income (Khan 2017).

Islamic finance is emerging as an alternative to conventional finance, which operates with interest, which is an unfair sharing. Islamic finance is defined as a financial system that operates according to the principles of Islamic law (Alrifai 2017; Harahap *et al.* 2023). Islamic finance can also be defined as providing the needed funds or utilizing excess funds using Islamic financial products by avoiding interest, excessive uncertainty, gambling, and haram goods and services within the framework of Islamic law rules (Kısacık 2021).

Islamic finance has shown significant growth in recent years and is strengthening its place in the financial system (Posumah 2024). Islamic finance is preferred not only by Muslims but also by those who do not belong to the Islamic religion.

Although it is called Islamic finance in the international literature, the term "Participation Finance" is preferred in Turkey. As a matter of fact, the banking and insurance sectors, which are participation finance components in Turkey, also operate as participation banks and participation insurance.

## THE EFFECTS OF THE ISLAMIC RELIGION ON SOCIAL LIFE IN THE FIELD OF ECONOMY AND FINANCE

Human is a social entity. Living alone is a difficult situation for a person. He depends on others even to meet his basic needs. Community life provides many benefits for humans who are social beings. People survive by purchasing goods and services produced by other individuals in society.

Community life has some disadvantages as well as the advantages of living together. One of the main disadvantages is that resources are not shared fairly. When resources created in sufficient quantities for people's needs are not shared fairly, some people live in luxury while others suffer from poverty.

The welfare of society is measured by the economy. In a fair economic system, the welfare of society also increases. Interest is the biggest obstacle to the fair sharing of resources. Because interest transfers resources from the poor to the rich. The main thing should be the transfer of resources from the rich to the poor. Unlike interest-based systems, Islamic economy and Islamic finance stand out as people-oriented.

Islamic economy and Islamic finance are based on the principle of fair sharing of resources. Sharing resources fairly ensures that social life is orderly. In just societies, theft, extortion, murder, etc. Situations such as these that would disturb public peace do not arise.

## CONCLUSION

Economy and finance are indispensable elements of social life. The world has become smaller with technological developments and easier communication and transportation. The importance of economy and finance has increased in the globalizing world.

Economics and finance practices also have an important place in sharing resources in social life. Meeting needs, delivering surplus assets to other people, etc. There is a need for economics and finance in these subjects.

In the conventional economy and financial system, resources are generally seized by the powerful. Resources are transferred from the poor to the rich, especially with interest. This unfair situation arising from interest has a negative impact on social life. Justice cannot be achieved in such societies where business is carried out on interest. In short, interest prevents justice and welfare in society.

Choosing Islamic economy and Islamic finance based on commercial activities instead of interest, which creates a system of exploitation, will have positive effects on social life. If Islamic economy and Islamic finance systems are implemented in accordance with the rules of Islamic law, justice and welfare will increase in society.

### Availability of data and material

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## LITERATURE CITED


Alrifai, T., 2017 *İslami Finans ve Yeni Finansal Sistem*. Buzdağı Yayınevi, Ankara.

Aydın, N., M. Başar, and M. Coşkun, 2015 *Finansal Yönetim*. Detay Yayıncılık, Ankara.

Bayındır, S., 2015 *Fıkhi ve İktisadi Açıdan İslami Finans (Para ve Sermaye Piyasaları)*. Süleymaniye Vakfı Yayınları, İstanbul.

Harahap, B., T. Risfandy, and I. N. Futri, 2023 Islamic law, islamic finance and sustainable development goals: A systematic literature review. Sustainability **15**: 6626.

Karadâğî, A. M., 2018 *İslam İktisadına Giriş Modern Ekonomiyle Mukayeseli Olarak Temellendirilmiş Bir Çalışma*. İktisat Yayınları, İstanbul.

Karakoç, S., 2013 *İslam Toplumunun Ekonomik Strüktürü*. Diriliş Yayınları, İstanbul.

Khan, M. A., 2017 *İslam İktisadına Giriş*. İktisat Yayınları, İstanbul.

Kısacık, H., 2021 *Katılım Finans Ürünleri ve Muhasebe Süreçleri*. Türkiye Katılım Bankaları Birliği Yayınları, İstanbul.

Kısacık, H., 2022 *Vade Farkı İle Faizin Karşılaştırılması ve Vade Farkının TMS/TFRS ve FFMS'lere Göre Muhasebeleştirilmesi*. Bilgin Kültür Sanat Yayınları, Ankara.

Okka, O., 2013 *Finansal Yönetim Teori ve Çözümlü Problemler*. Nobel Yayıncılık, Ankara.

Posumah, N. H., 2024 A comprehensive review of literature on the dynamics of islamic finance: Global growth and challenges. Management Studies and Business Journal (PRODUCTIVITY) **1**: 189–197.

Özer, M., 2009 *İktisadın Tanımı ve Temel Kavramlar*. Anadolu Üniversitesi Yayınları, Eskişehir.



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# Waqf Culture in the Ottoman Empire and Reflections of the Activities of Cash Waqfs on Today

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**ABSTRACT** It is known that waqf culture was quite widespread in the Ottoman state. Certain needs in society were met through waqfs. Cash waqfs were also established for financial needs. In this study, in which the prevalence of waqf culture in the Ottoman Empire and its reflections on society were tried to be discussed, the reflections of some of the debates that came with the emergence of cash waqfs to the present day were mentioned. In addition, the study investigated the activities of cash waqfs, what kind of benefits they provide to society, and how their continuity is ensured over time. Comments are included about the reason why cash waqfs, which are seen to be more common in the geography of Rumelia, are relatively less in the southern and eastern provinces. The parts of the discussions on cash waqfs that are misunderstood today are emphasized. In the conclusion of the study, the similar and different aspects of today's Islamic financial institutions and cash waqfs are compared.

**KEYWORDS**
Ottoman waqf culture
Cash waqfs
Islamic finance
Islamic banking

## INTRODUCTION

Helping a person in need is a human value. In fact, it is a uniquely human feeling for humans to help other living beings and meet their needs. Since cooperation cannot be individual, an organized force must emerge. In the Ottoman civilization, meeting needs, helping each other, etc. for different purposes waqfs emerged as an organized structure. Waqfs culture became so widespread in the Ottoman Empire that waqfs were established in every field. In addition to the waqfs that meet the needs of people, there have also been waqfs for plants and animals. Also, cash waqfs with to meet the financial needs of the society.

With cash waqfs, financial needs were tried to be met without interest-bearing transactions during the difficult times of the society in the Ottoman Empire. Cash waqfs, like today's Islamic financial institutions, operated in accordance with the rules of Islamic law. However, today's Islamic financial institutions operate not only for the purpose of mutual aid, like cash waqfs, but also for commercial gain.

## WAQF CULTURE IN THE OTTOMAN EMPIRE

Although the waqf, which literally means "to stop, halt", is a concept belonging to the Islamic religion, similar institutions existed before the Islamic religion. In the religion of Islam, it is accepted as the first waqf that Muhammad (S.A.V.) gave his land to the poor (Türkmen 2023).

In the vast Ottoman geography, the main duty of the state was to control security and production. Apart from this, services that directly contact people, such as municipal services, social services, and health services, were provided through waqfs (Sarıcaoğlu 2024; Yıldırım 2023; Türkoğlu 2013). Waqfs in cities established with a mosque at their center; It worked for the public benefit with madrasahs, libraries, hospitals, baths, guesthouses, bridges, fountains and many other construction elements. In addition, importance was given to its continuity. Ownership of waqfs does not belong to the person who founded the waqf (Ülker and Toraman 2012).

In the Ottoman Empire, a person could be born in a waqf house, study at a waqf school, have his needs met by waqfs, work in a workplace established by waqfs, and when he died, his funeral could be held through the waqfs and he could be buried in the waqf cemetery. In short, in the Ottoman Empire, a person could benefit from waqfs from birth to death. This situation comprehensively reveals that waqfs played an important role in every stage of life in the Ottoman Empire (Gursoy 2015).

In order to understand a civilization, it is necessary to examine every aspect of it. It should not be forgotten that each century has its own characteristics. But the fact that does not change here is; It is the feeling of doing good that comes with a person's nature and being happy when the good he does brings eternal benefit to people. This feeling is seen with the understanding of zakat and charity, which is obligatory in Islamic societies. Donations made

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solely for the sake of Allah (swt), without expecting anything in return, have contributed greatly to the development of the waqf's culture. The verse in the Holy Quran says "Believe in Allah and His Messenger, and make you successors over them and spend out of what He has given them authority to spend; whoever of you believes and spends, there will be a great reward for them." (Surah al-Hadid, verse 7) After faith, charity is mentioned and it is emphasized that humanity has been made the caliph of the earth and responsibility has been placed on each servant.

Acting with this sense of responsibility, Islamic societies have followed the path of meeting people's needs to the best of their ability, without waiting for the state to do so. Of course, it will be difficult for people in today's societies, who are spiritually blind and look for everything in material things, to understand this.

When the book published by the General Directorate of Waqfs of the Republic of Turkey under the name "Interesting Waqfs in History" is examined, it is seen that dozens of interesting waqfs were established in the Ottoman Empire. A few of the waqfs included in the book in question are listed below:

- The waqf that provides picnics to students, - The waqf that repairs pavements, - The waqf that wants doctors to be good-natured, - The waqf that bans tobacco for primary school teachers, - The waqf that distributing hot pita bread, - The waqf that helps poor singles get married, - The waqf that prepares dowries for girls, - The waqf that seed saving, - The waqf that protects storks, - The waqf that provides fruit feeding, - The waqf that carries snow to the dispensers in the heat.

As can be seen from the names of the waqfs listed above, care has been taken to meet any need in society, regardless of its field, through waqfs. In addition, through waqfs, people were treated with charity without harming their dignity.

It is recorded when a waqf is established in the Ottoman Empire. A waqf property has become a promise made in the way of Allah (swt), which a person voluntarily dispossesses, which cannot be inherited, cannot be sold, and cannot be used for purposes other than the purpose for which it was dedicated. That's why people were afraid of damaging waqf properties. Care has been taken to operate the waqfs, which are managed by a management called the board of trustees. The salaries of the managers could also be paid to the extent determined from the waqf's income. In many waqfs, management is voluntary and no fee is required. Waqfs registered and established by the Judge of the region where the waqf was established were subjected to serious inspections by the Judge himself or by appointed auditors (Kaya 2003). Cash waqfs are easier to establish than real estate waqfs. It has been easy for cash waqfs to become widespread because everyone can participate as much as they can, no matter how much or little. Not everyone may have enough money to have a mosque built, but they may have a few coins to donate to cash waqfs.

## CASH WAQFS

When the donated real estates are operated, the need to donate the cash that will be needed during their reconstruction has emerged due to their aging, falling into disrepair and dilapidation. In fact, cash waqfs are a complementary element of real estate waqfs. Cash waqfs existed in the Ottoman Empire has been operating since the 15th century (Okur 2005; Kızıldag *et al.* 2023). In the Ottoman Empire, a certain legal framework was prepared to ensure that the income from cash waqfs remained within the limits of the state. Therefore, at a time when bankers in Europe oppressed the people through high interest rates and usury became normal, the small financial needs of the people in the Ottoman Empire were met within the determined limits and without exaggeration. Usury was prevented in Ottoman lands and the debt ratio was ensured not to exceed a certain amount for centuries. In fact, cash waqfs have made a significant contribution to economic stability in this respect. The practices in cash waqfs controlled by the state were tightly controlled and were popular with the public. It is known that 46.12% of the waqfs established in Istanbul between 1456 and 1546, 31.77% of the waqfs established in the 18th century, and 56.81% of the waqfs established in the 19th century were cash waqfs (Öztürk 1995).

Nowadays, discussions about the functioning of cash waqfs are more common than discussions about their establishment. However, at that time, there was not much disagreement among scholars regarding the functioning of cash waqfs. Since it is essential that the income obtained from cash waqfs be spent on orphans, the poor and the needy, scholars have unanimously agreed that they are beneficial in this respect.

Cash waqfs, as a complementary element of real estate waqfs, have operated in Rumelia and Anatolia for centuries and have contributed to thousands of good deeds. When the reasons why there are more cash waqfs in Rumelia compared to the south and east of Anatolia and the Ottoman geography are investigated, it is understood that there is a difference in terms of the abundance of cash. In the Ottoman timar system, timar Sipahis were assigned to the Serhat tribes and were interested in cultivating the fields there, except in times of war, and these were mostly in the Southern and Eastern parts. Janissaries, who were professional soldiers, were assigned to the campaigns against the lands of Western societies, and they were mostly in Rumelia. They are active duty professional military officers. Janissaries were selected from the devsirme. Therefore, there would not be many kinship relationships. In the early periods, they were not allowed to marry. Since most of their needs were met by the state in kind and also given in salaries, they could not find many ways to use cash. They wanted to do charity by donating this money, which was more than they needed, to cash waqfs. It should be taken into consideration that this may be one of the reasons why there are many cash waqfs in Rumelia (Bulut and Korkut 2016).

## CASH WAQFS AND TODAY'S ISLAMIC BANKING SYSTEM

Islamic finance; It works on the principle of prohibition of interest, excessive uncertainty, gambling, illicit goods, and services. The Islamic financial system is a financial system where fair sharing by enduring risk is essential (Kısacık 2021). The Islamic banking system, which operates in the Islamic financial system, also operates on the basis of trade. In other words, just like in commercial activities, in the Islamic banking system, income is obtained by enduring risk.

Cash waqfs are considered the pioneer of Islamic finance (Sumer and Ondeş 2023). With the developments in information technologies, cash waqfs have transformed into the Islamic banking system. However, it cannot be said that the Islamic banking system is a complete continuation of cash waqfs. Because, as can be seen in the figure below, although cash waqfs and the Islamic banking system have similar aspects, they differ in some ways.

When cash waqfs and the Islamic banking system are compared, it is seen that money is not earned with money in both systems. It can be said that money is tried to be used in commercial activities, production, and in ways that will create employment and that it contributes to social welfare by preventing the accumulation of wealth in one hand due to the trade in goods. In short, both systems aim to provide financial services in accordance with the rules

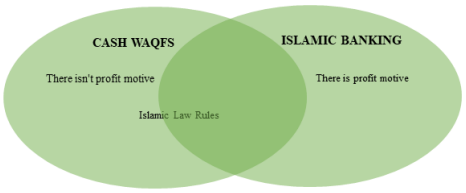


**Figure 1** Comparison of Cash Waqfs and Islamic Banking System

of Islamic law. However, cash waqfs do not aim for commercial gain since they are mutual aid organizations due to their mission. The earnings obtained from cash waqfs are used for charity. It is understood that cash waqfs maintain the income balance in society by transferring money from the rich to the poor. Although Islamic banks act in accordance with the rules of Islamic law, they are established for the purpose of generating commercial profits since they are businesses.

## CONCLUSION

In an economic system, the economic system is sustainable as long as it is prevented from using money to gain easy wealth, such as interest, which is prohibited (haram) in Islam. As we reduce the attractiveness of easy ways to increase wealth, social welfare will also increase as production, employment and exports will increase. First of all, excessive capital accumulation has created privileged groups in western societies with a capitalist mentality and unlimited interest, negatively affected social peace and caused civil unrest for centuries. Societies will be able to achieve prosperity to the extent that they can learn from history and with the principle of fair sharing of resources envisaged in Islam.

It is clearly seen during the period when cash waqfs, which aimed to operate in accordance with the rules of Islamic law, did not have the same impact on the economy as interest did in the Ottoman Empire. As in the European societies of the period, wealth was not concentrated in certain individuals with interest. Thanks to cash waqfs, wealth transfer took place from the rich to the poor, as it should be. It is understood that the purpose of establishing waqfs is to create social welfare through fair sharing in order to gain God's consent, as per religious belief.

Cash waqfs that emerged in the Ottoman Empire aim to meet the financial needs of the society in accordance with the rules of Islamic law. Today's Islamic financial institutions also operate for the same purpose. In short, Ottoman monetary waqfs and today's Islamic financial institutions meet the financial needs of the society by complying with the rules of Islamic law. The similar aspect of the institutions in question is their goals. In other words, both institutions aim to meet financial needs according to the rules of Islamic law. The different aspects of Ottoman cash waqfs and today's Islamic financial institutions emerge in terms of their commercial purposes. While Ottoman monetary waqfs were non-profit organizations, today's Islamic financial institutions are established for commercial gain. When the literature is examined, it is seen that there are intensive studies on waqf culture in the Ottoman state. However, it is observed that studies dealing with the reflections of the activities of cash waqfs on the present day are limited. In this context, the study is expected to contribute to the literature.

### Availability of data and material

Not applicable.

### Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

### Ethical standard

The authors have no relevant financial or non-financial interests to disclose.

## LITERATURE CITED

Bulut, M. and C. Korkut, 2016 Finansal İstikrar ve para vakıfları etkisi: Rumeli para vakıfları Örnekleri. İslam Ekonomisi ve Finansı Dergisi (İEFD) **2**: 55–76.

Gursoy, C., 2015 *Osmanlıda Para Vakıflarının İşleyişi ve Muhasebe Uygulamaları: Davudpaşa Mahkemesi Para Vakıfları*. Ph.D. thesis, İstanbul Üniversitesi Sosyal Bilimler Enstitüsü, Yayınlanmamış Doktora Tezi.

Kaya, S., 2003 Para vakıfları Üzerine. Türkiye Araştırmaları Literatür Dergisi pp. 189–203.

Kısacık, H., 2021 Islamic finance and accounting process for business growth and development. In *Theoretical And Empirical Perspectives On Economic And Financial Issues*, edited by Şahin Karabulut, Gazi Kitabevi, Ankara.

Kızıldag, N., C. Kayahan, and i. Görkaş, 2023 Osmanlı dönemi eytâm sandıklarından modern bankacılığa geçiş. Muhasebe ve Finans Tarihi Araştırmaları Dergisi pp. 51–66.

Okur, K. H., 2005 Para vakıfları bağlamında osmanlı hukuk düzeni ve ebussuud efendinin hukuk anlayışı Üzerine bazı değerlendirmeler. Hitit Üniversitesi İlahiyat Fakültesi Dergisi **4**: 33–58.

Sarıcaoğlu, M. E., 2024 H. 1077/m. 1666 tarihli vakıf muhasebe defterine göre Şehzâde mehmed külliyesi'ndeki vakıfların gelir-gider kayıtları. Kırıkkale Üniversitesi Sosyal Bilimler Dergisi **14**: 49–70.

Sumer, S. and T. Ondeş, 2023 Para vakıfları ve katılım bankalarının fon kullandırma yöntemlerinin karşılaştırılması. Accounting & Financial History Research Journal/Muhasebe ve Finans Tarihi Araştırmaları Dergisi pp. 111–117.

Türkoğlu, İ., 2013 Osmanlı devletinde para vakıflarının gelir dağılımı üzerindeki etkileri. Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi **18**: 187–196.

Türkmen, Ö. S., 2023 Amasya ve Çevresinde kurulan para vakıfları Üzerine bir İnceleme. Uluslararası Sosyal ve Eğitim Bilimleri Dergisi pp. 1–21.

Yıldırım, M., 2023 Nakdî sermaye aktarımı ve borçlu portföyü açısından para vakıfları: İstanbul Örneği (1710-1715). Dicle Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi **13**: 136–154.

Öztürk, N., 1995 *Türk Yenileşme Tarihi Çerçevesinde Vakıf Müessesesi*. TDV Yayınları, Ankara.

Ülker, Y. and C. Toraman, 2012 Osmanlı devletinin sosyal ve ekonomik hayatında para vakıflarının rolü ve muhasebe uygulamaları. Manas Sosyal Araştırmalar Dergisi **1**: 55–84.

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# New Specializations in Accounting Profession

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**ABSTRACT** Humans have innumerable needs, and every economic unit that engages in activities to meet these needs is called a business. As a result of the activities of businesses, transactions must be documented and recorded. The concept of accounting has emerged for this purpose. Accordingly, the profession of accountancy has developed and people who do this job have been trained. Currently, professionals such as Certified Public Accountant and Sworn-in Certified Public Accountant have emerged. The field of accounting has been significantly impacted by the rapid advancement of information technologies and economies on a global scale, the phenomenon of globalization, and the intensifying competitive landscape. In response to the increasingly complex business activities, the content of transactions carried out by accountants has also become of paramount importance. Significant alterations have been observed in domains such as corporate governance, auditing, and financial reporting. In consequence of these developments, new areas of specialisation in accounting have emerged. This study begins with an examination of the concept of accounting and the evolution of the accounting profession. It also considers the emergence of new specializations within the accounting profession and selected topics within these specializations.

**KEYWORDS**
Accounting profession
New specializations in accounting

## INTRODUCTION

The intensification of global competition, particularly in information technology and economic sectors, has prompted a transformation in accounting processes within enterprises. This has led to a shift in the nature of transactions conducted by accountants, with their role becoming increasingly pivotal in navigating the complexities of business operations. In addition to these developments, there have been advances in the areas of corporate governance, auditing, and financial reporting, among others. The winds of change in the fields of accounting have opened up new areas of expertise.

In light of these developments, professionals have been compelled to reconcile the divergent demands of financial statement users with the tenets of traditional accounting practices. The accounting profession has witnessed the emergence of numerous new areas of expertise, including independent auditing, internal auditing, business valuation, corporate governance and rating, forensic accounting, carbon accounting, environmental accounting, fraud auditing, financial reporting consultancy, and others. These developments have created new business opportunities for professionals to provide consultancy services. The capacity of accounting professionals to adapt to these developments in new areas and to implement changes will only be realized through training and self-development on these issues and areas. This study presents theoretical information and evaluations on the development of the accounting profession and new areas of specialization.

## ACCOUNTING CONCEPT AND DEFINITION

Humans are innately driven by a multitude of needs. Every economic entity that is engaged in the pursuit of these needs is designated as a business. Businesses are analyzed in two distinct ways: structurally and operationally. In the structural analysis of enterprises, certain elements are considered, including capital, labor, and organization. Secondly, the activities of businesses can be broadly categorised into three main areas: procurement, production and marketing. Enterprises engage in payments as a consequence of procurement activities and collections as a consequence of marketing activities. Consequently, it is imperative to maintain records of transactions that occur throughout the various stages of business operations (Şenol 2018). The commercial activities of enterprises result in the transfer of wealth and the occurrence of numerous changes and transformations. It is necessary to evaluate and document the results of these activities. In order to conduct this process in an orderly manner, it is necessary to consider the importance of the concept of accounting. The concept of accounting in its most general sense.

The field of accounting is defined as "a branch of science that records, classifies, summarizes, reports, analyzes, and interprets

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the financial transactions of enterprises that cause changes to their assets and resources" (Özkan 2020). In other words, it is an information system that produces financial information for information users.

## DEVELOPMENT OF THE ACCOUNTING PROFESSION AND SYSTEM IN TURKEY

The evolution of the Turkish accounting system can be traced back to ancient times. The most significant development in the history of the accounting profession subsequent to the Tanzimat was the enactment of the Law of Commerce in 1850. This law was a translation of the first and third books of the *Code Commerce*, which entered into force in France in 1807. The first book addressed the subject of merchants and trade, while the third book dealt with the topic of bankruptcies and fraudulent bankruptcies. It is the inaugural legal regulation to impact our accounting practices (Sipahi and Küçük 2011).

The period during which Germany exerted influence on the development of accounting theories and practices in Turkey on a national scale is generally considered to have commenced after 1926. The Commercial Code No. 856, the inaugural commercial code of the Turkish Republic, was adopted and entered into force on May 29, 1926. It was prepared on the basis of the German Commercial Code. Consequently, the German influence began to be evident in the Turkish accounting system (Şenel and Arslan 2019).

The enactment of Law No. 755 on earnings tax in 1926 marked the advent of the Republic period and represented the inaugural and most significant development in this era. Subsequently, it underwent numerous modifications with the enactment of the Earnings Tax Law, No. 2395, which was ultimately abolished in 1949. In lieu of the abolished earnings tax law, the income tax law, corporate tax law, and tradesmen tax law were adopted. In 1952, with Turkey's accession to NATO membership, the influence of the United States in the regulations increased. Nevertheless, the initial steps towards the implementation of the Uniform Accounting System were taken subsequent to these years. In the subsequent periods, international accounting standards exerted an influence on the accounting system and practices of our country, as accounting standards became a necessity to create a common language in economic and commercial practices and calculations worldwide. In Turkey, the principles and elements of the accounting profession were established and regulated by Law No. 3568 on Certified Public Accountants and Sworn-in Certified Public Accountants, enacted on June 1, 1989.

## NEW AREAS OF SPECIALIZATION IN THE ACCOUNTING PROFESSION

The rapid development of information technologies and the economy, in conjunction with increasing competition and globalization, have had a profound impact on the accounting processes of enterprises. In response to the increasingly complex business activities, the content of transactions performed by accountants has become more diverse and significant. In particular, the impact of changes in areas such as corporate governance, auditing, and financial reporting has led to the emergence of new and distinct accounting specialization areas within the field of accounting (Yıldız and Akyel 2018). The new areas of specialization are discussed under six main headings: auditing, accounting standards, environmental accounting, valuation, accounting information systems, and strategic cost management. These are presented in the following paragraphs.

### Auditing

The concepts of accounting and auditing are inextricably linked. The necessity of audit implies the necessity of accounting, and vice versa. The forensic accounting profession, which provides litigation support, fraud audit, and expert witness services, has developed new specializations in the field of auditing in the accounting profession, in collaboration with the internal auditor.

The provision of reliable and high-quality financial information and reporting is of significant importance for the healthy conduct of commercial relations between businesses and related parties in the context of economic decision-making. The assurance of the accuracy and reliability of the financial information of enterprises depends on the independent audit mechanism, which is carried out in accordance with ethical rules and professional standards (Yıldız and Akyel 2018). The implementation of rigorous and comprehensive regulations at the country level has facilitated the growth of independent audit services, paving the way for companies to demand a range of new services, including the establishment of internal audit and internal control systems, the valuation of assets and companies, corporate governance practices, consultancy on various issues, and the measurement of credibility (Sayar and Karataş 2017).

### Environmental Accounting

Environmental accounting is an information system that produces data on the formation of resources related to the environment and the manner in which these resources are utilized, the fluctuations in these resources, and the environmental status of organizations, which are then communicated to the relevant individuals and organizations (Çetin *et al.* 2004). In accordance with the social responsibility concept of accounting, companies are obliged to disclose the impact of their activities to all segments of society, not only in terms of economic results, but also taking into account the social consequences (Atmaca 2020). The significance of environmental accounting, environmental costs, and environmental reporting has been on the rise in enterprises due to the mounting demand for information from shareholders and other stakeholders, in conjunction with the growing emphasis on corporate social responsibility. The incidence of environmental costs may vary according to the manner in which they are incurred. While some environmental costs are incurred as a consequence of activities undertaken with the objective of preserving the environment, others may arise as a result of the utilisation of environmental resources. Table 1 presents of these typess of costs.

### Accounting Standards

By Turkish Commercial Code No. 6102, which regulates the application of accounting standards, all enterprises were required to comply with Turkish Accounting Standards (TAS) / Turkish Financial Reporting Standards (TFRS) in the preparation of their financial statements as of 2013. This requirement was further reinforced by the decision of the Public Oversight Accounting and Auditing Standards Authority (POA), as published in the Official Gazette dated August 26, 2014. The mandatory application of TAS/TFRS in the preparation of individual and consolidated financial statements of organizations of public interest (Yıldız and Akyel 2018). The preparation of Turkish Accounting Standards has been entrusted to the Turkish Accounting Standards Board since 2002. As of September 2011, the name of the board was changed to "Public Oversight Accounting and Auditing Standards Authority."

**Table 1 Distribution of Environmental Costs (Alagöz and Yılmaz 2001)**

| Cost reduction | Utilization costs | Loss Costs |
|---|---|---|
| Environmental Planning | Air Cost | Air Pollution |
| Process Control | Water Cost | Water Pollution |
| Emission Measurement Instruments | Soil Cost | Visual Pollution |
| Environmentally Harmless Material Design Development | Noise Cost | Penalties and Compensations |
| Recycling Designs Environmentally Harmless Packaging Development | Image Cost | Environmental Cleanup |
| Environmental Development | Natural Gas Cost | Complaint Investigations |
| Environmental Education | Oil Cost | Bail and Warranty Expenses |
| Biologist, Chemist Services | Coal Cost | Sales Declines |
| Environmental Engineering Services | Energy Cost | Other Loss Costs |
| Environmental Reports | | |
| Environmental Labels | | |
| Environmental Reliability | | |
| Environmental Management System | | |
| Environmental Audit | | |

The POA has published many accounting standards, including Turkish Auditing Standards (TAS), Turkish Accounting Standards (TAS), Turkish Financial Reporting Standards (TFRS), Financial Reporting Standard for Large and Medium-Sized Enterprises (BOBİ FRS), Financial Reporting Standard for Small and Micro Enterprises, and Interest-Free Financial Accounting Standards (FFMS) (Atmaca 2020). For members of the accounting profession to overcome the difficulties they encounter when they comply with these standards, they must possess expertise in this field.

### Strategic Cost Management

In the context of globalization, there have been notable advancements in the field of strategic cost management (SCM), which is closely related to strategic management. Strategic cost management is a field of study that focuses on the strategic elements related to strategic management. The primary objective of strategic cost management is to devise strategies to safeguard and enhance the competitiveness of the business in the context of a global competitive environment (Haşaşoğlu 2011). Strategic cost management is the application of cost management techniques to continuously improve the strategic position of businesses and reduce their costs. In this framework, several additional methods are employed, including activity-based costing, product life cycle costing, target costing, kaizen costing, and quality function deployment. These are used as auxiliary methods in value chain analysis, strategic position analysis, and cost drivers analysis of SMM.

The aforementioned specialization areas represent novel developments within the accounting profession, reflecting the evolving demands of the modern age. It is inconceivable for members of the accounting profession to remain indifferent to the new areas of specialization that are emerging within the profession. Otherwise, members of the accounting profession will be unable to keep pace with the evolving demands of the modern age and will be unable to meet the evolving information needs of financial information users, which are being shaped by technological developments and globalization (Atmaca 2020). A unifying characteristic of these specialization areas is that they utilize accounting data in their calculations and examinations.

### Accounting Information System

An Accounting Information System (AIS) is an information system that transforms, reports, and presents historical and estimated data related to financial accounting, cost accounting, and managerial accounting into information that meets the expectations of information users. This is due to the characteristics and qualities of information that users require (Sürmeli *et al.* 2008). The components of a management information system (MIS) are presented in Table 2.

### Evaluation

Valuation, which has been regarded as a fundamental aspect of the accounting information system throughout history, is also intricately linked to the taxation process. One of the key objectives of the valuation phenomenon is the determination of fair value, which is regarded as an essential tool for the accurate financial presentation and measurement process within the scope of TAS/TFRS. This process is underpinned by the concepts of transparency and accountability.

The valuation approaches employed in the context of tax law and commercial law diverge in terms of the objectives they are de-

**Table 2 Accounting Information System Components (Kaynar 2010)**

| ACCOUNTING INFORMATION SYSTEM | | |
|---|---|---|
| Knowledge Users | Financial Information Provided | Supported Resolutions |
| Investors | Profitability | Performance evaluation |
| Lenders | Financial Status | Securities investments |
| Managers | Cash Flows | Tax strategies |
| Shareholders | | Labor relations |
| Customers | | Resource allocation |
| Employees | | Lending decisions |
| Regulatory Authorities | | Borrowing decisions |
| CMB | | |
| Revenue Administration | | |
| Ministry of Environment | | |

signed to fulfill. Commercial law is founded upon the principles of mercantilism and is designed to elucidate the true circumstances of the merchant and to furnish pertinent and realistic data regarding the activities and outcomes of the enterprise to the individuals and entities associated with the enterprise. Conversely, in terms of tax laws, the valuation provisions are based on the tax, focusing on the tax base and organizing all its regulations on the full and correct calculation of the tax as the commanding officer of the tax. Following the Tax Procedure Law, valuation is defined as "the process of appraising and determining the economic value of assets related to the calculation of tax bases." (Güngör 2013).

## NEW SPECIALIZATION AREAS IN THE ACCOUNTING PROFESSION: SELECTED TOPICS

The following paragraphs will provide an overview of selected topics related to new specializations in accounting.

### Carbon Accounting

The concept of "carbon accounting" has emerged as a sub-branch of environmental accounting as a result of the importance of accounting for carbon emissions, which play an important role in global climate change. These emissions are generated by human activities that cause global warming, and thus, they must be accounted for within the framework of the accounting information system (Demircioğlu and Ever 2020).

Carbon accounting is defined as the process of collecting detailed data on an organization's activity, calculating the carbon projection, in other words, carbon emissions, and converting this figure into carbon dioxide equivalent by taking into account the emission factors (Uyar and Cengiz 2011). The primary objective is to quantify the carbon emissions in a given region to facilitate the sustainability of enterprises engaged in the conversion of carbon emission amounts calculated by accounting methods into carbon dioxide equivalents (Duman *et al.* 2012).

### Water Accounting

One of the most significant global challenges of the 21st century is the water problem, which has a profound impact on economic, environmental, and social sustainability. Severe droughts caused by climate change, prolonged periods of water scarcity, floods, and the excessive and unconscious use of water by the growing population, along with the ineffective management of water by managers, have collectively drawn attention to water as a source of life (Öztürk and Ceran 2022).

The field of water accounting encompasses not only the recording of direct and indirect water use by organizations and the amount of wastewater generated, but also the evaluation of the risks associated with water and the examination of the impact of these factors on stakeholders. In other words, it encompasses the measurement and reporting of the water used directly or indirectly, the effects of this use, and the contributions of the organization to water resources (Gökten 2017). The first organized instance of water accounting occurred at the United Nations Conference on the Human Environment in Stockholm in 1972. This marked the first time that the issue was addressed on a global scale as an environmental problem. Although water accounting is considered a sub-branch of environmental accounting, the GRI 303 Water Standard, published in 2016, treats water accounting as a separate branch.

The concept of the water footprint, which is essentially a metric for evaluating water resources in relation to human consumption, was initially proposed by Arjen Hoekstra at UNESCO-IHE in 2002. The term "water footprint" is defined as the total amount of clean water resources utilized for the production of goods and services consumed by an individual or society, or by the producer for the production of goods and services (Kayhan 2020).

### Lean Accounting

The objective of lean accounting is to adapt lean thinking to accounting and performance measurement systems in a manner con-

sistent with lean production. Businesses that prioritize processes and customer value, streamline transactions, processes, reports, and accounting systems, and embrace continuous improvement at all levels of the business can achieve this (Çeviren and Türk 2018). The foundation of lean accounting is lean production and lean thinking.

Lean production is a philosophical approach that is based on satisfying customers by producing quality products at the time they are needed, at the desired quality, using the minimum materials, tools, equipment, space, labor, and time (Atmaca 2020). The primary objective of this production system is to eliminate waste. In order to prevent waste, it is essential to understand the concept of zero error and zero stock.

Since the early 1990s, the lean manufacturing approach has emerged as the dominant paradigm for the creation of highly efficient production processes (Uluç 2022). The lean production system was developed by Taiichi Ohno and Eiji Toyoda in the 1940s and 1950s at the Motor Factory of the Japanese Toyota company. Its primary objective is to eliminate waste. For this reason, the term "lean production" was first applied to this system, known as the Toyota Production System, by researcher John Krafcik (Atmaca 2020).

### Green Accounting

There is a divergence of opinion among scholars as to whether green accounting should be considered as the same concept as environmental accounting or as a different concept. The objective of both forms of accounting is to ascertain the value of natural resources and to prevent the inefficient use of these resources (Yılmaz and Şahin 2017). Green accounting is defined as the process of identifying, measuring, and communicating information about an organization's performance concerning the environment to inform economic decision-making. In another study, green accounting is defined as the recording of positive or negative impacts resulting from the use of environmental resources (Tanç and Gökoğlan 2015). Green accounting practices confer the following benefits to businesses (Yelgen 2022).

- This strategy enhances the reputation of businesses and their ability to garner the support of key stakeholders.
- Furthermore, it assists in enhancing the share value and enterprise value of businesses.
- Furthermore, it contributes to the long-term sustainability of operations by supporting the generation of corporate profits.
- Furthermore, it encourages the sustainable growth of businesses.

### Creative Accounting

The concept of creative accounting first emerged in the Anglo-Saxon literature in the 1970s, when it was employed in the examination of bankrupt businesses. Nevertheless, the author Ian Griffiths published a book titled "Creative Accounting" in 1986, which contributed to the concept's prominence (Durak and Esmeray 2021).

In an optimal economic environment, managers would not possess the motivation to engage in creative accounting or fraud. Business activities are conducted by the expectations of managers and external stakeholders. In an ideal economic environment, managers would not have incentives to engage in creative accounting or fraud. Consequently, excellent operating results would not lead to high bonuses from the managerial point of view and high stock prices from the external environment point of view. However, in practice, businesses do not always meet expectations. This situation is regarded as the point at which problems arise and attractive opportunities for creative accounting emerge (Nazlıoğlu and Gürdal 2020). Creative accounting can be defined as the process of measuring and presenting financial information in a way that takes advantage of the existing flexibilities in accounting, provided that it remains within legal limits. This approach gives priority to the priorities of those who prepare this information rather than the needs of those who use accounting information (Aygün 2013). Some examples of creative accounting methods include increasing revenues, assets, and cash flows, as well as reducing expenses and liabilities.

### Forensic Accounting

Forensic accounting has been acknowledged as a significant profession in developed countries, particularly in the USA, since the 1980s and has begun to emerge as a discipline. Forensic accounting is an integrated specialization that encompasses accounting, auditing, and research skills (Çankaya *et al.* 2014). Forensic accounting can be considered the nexus where the domains of law and accounting converge. Consequently, the majority of activities related to forensic accounting fall within the purview of civil and criminal law. Forensic accounting and forensic accounting investigations typically encompass financial crimes related to civil and criminal law, as well as the filing of lawsuits related to these crimes. Additionally, they encompass the accounting information utilized to conclude cases related to these crimes in the court process (Çeliker and Aygün 2018). The concept of forensic accounting is a relatively recent phenomenon in Turkey, with the United States of America serving as its primary source of inspiration. Forensic accounting has also been partially implemented in Canada and European Union countries. As a novel concept, there is no universally accepted definition of forensic accounting (Gülten 2010).

Forensic accounting is a profession that plays a pivotal role in the detection of fraud and the resolution of legal disputes. It can be defined as "a field that requires a good knowledge of accounting, law, and auditing, as well as having equipment, knowledge, and data in areas such as economics, finance, tax, quantitative methods, statistics, information processing programs and technologies, psychology, research techniques, and criminology, analyzing, evaluating, investigating, and revealing accounting facts in all aspects by using audit techniques and methods" (Altunay 2021).

A forensic accountant is an individual who possesses the requisite professional knowledge and qualifications to fulfill the duties and responsibilities of a forensic accountant. Forensic accountants, also known as forensic auditors or investigative auditors, are engaged in a diverse range of activities, including recovery, merger, compensation, and the reinterpretation of contracts signed between the parties involved in commercial relations, whether between individuals, businesses, or institutions (Çeliker and Aygün 2018). Although the forensic accountancy profession is similar to the auditing profession, there are significant differences between them. These distinctions are elucidated in Table 3.

The extensive range of forensic accounting activities has resulted in the categorization of the profession. In general, the profession is divided into three categories: fraud auditing, litigation support consultancy, and expert witness.

***Fraud Audit*** An expert in the field of accounting possesses the requisite professional knowledge and qualifications and provides services for the prevention or detection of accounting fraud. Fraud auditing or investigative accounting services, which are applied in the event of uncertainty regarding the accuracy, reliability, and

**Table 3 Differences between Forensic Accountant and Auditor (Aracı and Çevik Ozcan 2019)**

| Forensic Accountant | Auditor |
|---|---|
| 1) The individual in question is responsible for investigating instances of fraud within companies. | 1) Ensures that companies adhere to regulations and policies. |
| 2) The individual in question is well versed in both audit techniques and criminological techniques. | 2) Utilizes audit techniques to identify errors and deficiencies. |
| 3) Possesses greater expertise in conducting interviews and gathering information from staff. | 3) The individual in question lacks the requisite expertise to conduct interviews and gather information from staff members in the same manner as a forensic accountant. |
| 4) It is not limited to the ability to examine accounting documents and books to ascertain whether the balance sheet has been prepared by accepted standards. The individual in question can identify criminal transactions within the financial records of any given unit. | 4) Verifies the compliance of accounting documents and books with legislation, including the preparation of the balance sheet by established standards. He lacks the experience of a forensic accountant in the misuse of data. |
| 5) In the process of gathering evidence, they possess a greater understanding of the most fruitful avenues for investigation, the types of evidence that should be sought, the most effective methods for extracting it, and the criteria for determining whether the evidence is relevant and valid. | 5) In contrast to a forensic accountant, the role does not involve extensive research. |
| 6) They are more familiar with how employees may misuse or abuse controls and processes, as well as the various fraud methods that may be employed to circumvent internal controls. | 6) The individual in question is less familiar with how employees may misuse or abuse controls and processes, as well as the various fraud methods used to circumvent internal controls than a forensic accountant would be. |

transparency of financial information, extend beyond the activities conducted in response to the occurrence of fraud and irregularities. They also encompass the activities that should be undertaken to prevent such occurrences (Şenel and Arslan 2019).

***Litigation Support Consultancy*** Litigation support consultancy is a specialized service provided to the relevant judicial authorities or attorneys before or during a lawsuit, with the objective of assisting in the application of the forensic accounting profession. Litigation support consultancy is more concerned with the economic dimension of the case. A typical example of litigation support provided by a forensic accountant is the calculation of a financial loss resulting from a breach of contract between the parties or any negligence or violation (Çankaya *et al.* 2014).

***Expert Witness*** A person whose evidence is accepted by a court or other judicial authority to help resolve a dispute or to reach the truth, and who reaches an opinion based on specific expertise and knowledge (Aracı and Çevik Ozcan 2019).

## CONCLUSION

Furthermore, developments in financial reporting and accounting auditing have also affected the areas of responsibility of the accounting profession. Accounting has evolved from a system that primarily generates record and tax-oriented information to one that is increasingly influenced by developments in the business environment and that is capable of self-renewal. This transformation has elevated the significance of professional expertise in a multitude of domains, including auditing, financial reporting standards, valuation, accounting information systems, integrated reporting, environmental accounting, cost management, and others. It has also fostered the emergence of novel areas of expertise within the accounting profession.

Professionals must adapt to new areas of expertise that have emerged in response to the diverse needs of financial statement users, in addition to conventional accounting practices. Concurrently, the emergence of new areas of expertise within the accounting profession, including independent auditing, internal audit-internal control, valuation, forensic accounting, carbon accounting, environmental accounting, fraud auditing, and financial reporting consultancy, has created new job opportunities in the form of consultancy services.

In light of the evolving global landscape, it is anticipated that new accounting specializations will emerge in various fields, establishing themselves as prominent areas of expertise. The emergence of new specializations in accounting is of significant consequence in terms of fostering awareness in a multitude of domains. It will be possible for members of the accounting profession to adapt to developments in these areas and implement changes in these areas by receiving training on these issues and developing themselves in these areas.

### Availability of data and material

Not applicable.

### Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

### Ethical standard

The authors have no relevant financial or non-financial interests to disclose.

## LITERATURE CITED


Alagöz, A. and B. Yılmaz, 2001 Çevre "muhasebesi ve Çevresel maliyetler". Sosyal Ekonomik Araştırmalar Dergisi **1**: 147–158.

Altunay, M. A., 2021 "adli muhasebe İle İlgili ulusal lisansüstü tezlerin bibliyometrik analizi (2004-2020)". Journal of Accounting and Taxation Studies **14**: 1261–1298.

Aracı, H. and E. Çevik Ozcan, 2019 "adli muhasebe: Adli muhasebecilik mesleği yetkinlikleri, Önemi ve türkiye'deki yeri". Yönetim Ve Ekonomi Dergisi **26**: 801–813.

Atmaca, P., 2020 *Muhasebe Mesleğinin Bugünü ve Geleceği: Meslekte Uzmanlaşma*. Master's thesis, Cumhuriyet Üniversitesi SBE, Sivas.

Aygün, D., 2013 "yaratıcı muhasebe stratejileri". Eskişehir Osmangazi Üniversitesi İİBF Dergisi **8**: 49–69.

Şenel, S. A. and O. Arslan, 2019 Muhasebe skandallarının Önlenmesinde adli muhasebe mesleğinin rolü. SCÜ İİBF Dergisi **20**: 293–308.

Demircioğlu, E. and D. Ever, 2020 Karbon maliyetlerinin belirlenmesine İlişkin demir Çelik İşletmesinde uygulama. İşletme Araştırmaları Dergisi **12**: 649–662.

Duman, H., R. Özpeynirci, M. Yücenurşen, and H. Bağcı, 2012 "karbon muhasebesi". Sosyal Ekonomik Araştırmalar Dergisi **12**: 105–120.

Durak, E. and A. Esmeray, 2021 "yaratıcı muhasebe kavramı ve muhasebe meslek mensuplarının bilgi düzeylerinin Ölçülmesi". İşletme Akademisi Dergisi **1**: 217–234.

Gökten, P., 2017 "su muhasebesi ve gri 303 su 2016 sürdürülebilirlik raporlaması standardı". Muhasebe Bilim Dünyası Dergisi **19**: 957–980.

Gülten, S., 2010 "adli muhasebe kavramı ve adli müşavirlik mesleği". Ankara Barosu Dergisi .

Güngör, M., 2013 Değerleme kavramı ve Ölçüleri. Vergi Raporu Dergisi .

Haşaşoğlu, U., 2011 *Stratejik Maliyet Yönetim Aracı: Hedef Maliyetleme*. Master's thesis, Karamanoğlu Mehmet Bey Üniversitesi, SBE, İşletme Anabilim Dalı, Karaman.

Kayhan, Y., 2020 *Eşen Çayında Bulunan Alabalık Çiftliklerinde Su Ayak İzi Ve Su Muhasebesi*. Master's thesis, Mersin Üniversitesi Fen Bilimleri Enstitüsü, Mersin.

Kaynar, Y., 2010 *Muhasebe Bilgi Sisteminde Üretilen Temel Performans Göstergelerinin Karar Verme Süreçlerinde Kullanılması*. Master's thesis, Gazi Üniversitesi, SBE, Ankara.

Nazlıoğlu, B. and K. Gürdal, 2020 "yaratıcı muhasebe ve bankalar Üzerinde bir uygulama". Üçüncü Sektör Sosyal Ekonomi Dergisi **55**: 1040–1059.

Özkan, M., 2020 Dünden bugüne belirsiz dünyada muhasebe. Muhasebe ve Finans Tarihi Araştırmaları Dergisi pp. 135–179.

Sayar, Z. and M. Karataş, 2017 "muhasebe ve denetim alanında yaşanan son gelişmeler İle muhasebe mesleğinde yeni trendler". Mali Çözüm Dergisi **27**: 13–28.

Şenol, M. M., 2018 *Muhasebe temel kavramları açısından muhasebe uygulamalarının değerlendirilmesi: Sivas ilinde bir araştırma*. Master's thesis, Sosyal Bilimler Enstitüsü.

Sipahi, B. and İ. Küçük, 2011 Türk ticaret kanunları ve muhasebenin gelişimine etkilerinin 160 yıllık Öyküsü. Muhasebe Ve Finans Tarihi Araştırmaları Dergisi pp. 181–193.

Sürmeli, F., M. Erdoğan, N. Erdoğan, K. Banar, E. Kaya, *et al.*, editors, 2008 *Muhasebe Bilgi Sistemi*, volume 895 of *AÖF Yayınları*. Anadolu Üniversitesi Yayınları, Eskişehir.

Tanç, A. and K. Gökoğlan, 2015 The impact of environmental accounting on strategic management accounting: A research on manufacturing companies. International Journal of Economics and Financial Issues **5**: 566–573.

Uluç, S. M., 2022 Yalın muhasebe konusunda türkiye'de yapılan araştırmalara yönelik bir değerlendirme. Socrates Journal Of Interdisciplinary Social Studies **20**: 20–38.

Uyar, S. and E. Cengiz, 2011 "karbon (seragazı) muhasebesi". Mali Çözüm Dergisi pp. 47–68.

Yelgen, E., 2022 Yeşil muhasebe ve uygulama Örnekleri Üzerine bir Çalışma. Yönetim Bilimleri Dergisi (Özel Sayı) pp. 100–126.

Yıldız, c. and N. Akyel, 2018 Yeni muhasebe uzmanlık alanlarının muhasebe eğitimindeki yeri ve türkiye Örneği. Muhasebe Ve Finansman Dergisi pp. 47–66.

Yılmaz, Z. and Z. Şahin, 2017 "muhasebe dersi alan Öğrencilerin yeşil muhasebe konusundaki algıları ve farkındalıkları". Balkan ve Yakın Doğu Sosyal Bilimler Dergisi **3**: 110–122.

Çankaya, F., E. Dinç, and Y. Çoban, 2014 "adli muhasebede uzman tanıklık mesleği: Muhasebe meslek mensupları Üzerine bir araştırma". Journal of Management and Economics Research **12**: 70–94.

Çeliker, F. and M. Aygün, 2018 "adli muhasebe ve İlgili tarafların algı düzeyleri: Van Örneği". Van Yüzüncü Yıl Üniversitesi İİBF Dergisi **3**: 151–166.

Çetin, A. T., M. Özcan, and R. Yücel, 2004 "Çevre muhasebesine genel bakış". Sosyal Ekonomik Araştırmalar Dergisi **4**: 61–76.

Çeviren, S. M. and Z. Türk, 2018 "yalın Üretim ortamında yalın muhasebe ve yalın performans değerlemesi". Osmaniye Korkut Ata Üniversitesi İİBF Dergisi **2**: 221–245.

Öztürk, M. and Y. Ceran, 2022 "su muhasebesi ve türkiye'de güncel durum". Yaşar Üniversitesi E-Dergisi **17**: 913–929.



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