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Early Detection of Financial Distress at PT. Garudafood Putra Putri Jaya Tbk Using Machine Learning Algorithms

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ABSTRACT

This study aims to develop an early warning system for detecting potential financial distress at PT Garudafood Putra Putri Jaya Tbk using Machine Learning (ML) algorithms. A quantitative case study approach was employed using publicly available quarterly financial statements from 2019 to 2024. The dataset consisted of quarterly financial observations representing the company's financial condition during the observation period. Data preprocessing included normalization, missing value handling, outlier detection, and feature selection using the Chi-Square test to identify the most influential financial ratios. Five Machine Learning algorithms were implemented and compared, namely Logistic Regression, Random Forest, Naive Bayes, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM). Model evaluation was conducted using accuracy, precision, recall, F1-score, and 5-fold cross-validation techniques to improve model reliability and reduce overfitting risk. The results indicate that the Random Forest algorithm achieved the highest performance with an accuracy of 85.71%, precision of 100%, recall of 66.67%, and F1-score of 80%. Operating Profit Margin and Debt to Asset Ratio were identified as the most significant indicators in detecting financial distress. This study contributes to the financial distress prediction literature in Indonesia by demonstrating the effectiveness of quarterly financial reports and Machine Learning approaches in developing adaptive early warning systems for the manufacturing sector. Practically, the proposed model can assist management, investors, and regulators in proactively monitoring financial risk and anticipating potential bankruptcy conditions.

Keywords: Financial Distress; Financial Ratios; Machine Learning; Early Warning System

1. INTRODUCTION

The food and beverage industry in Indonesia is one of the leading sectors that has consistently shown positive growth year after year (Setiawan et al., 2022). The dominance of this sector in the domestic market is inseparable from its strategic role as the backbone of national manufacturing industry growth. This growth is supported by Indonesia's large population, increasing urbanization, and changes in lifestyle that drive the consumption of processed food products and ready-to-drink beverages (Nurhasan et al., 2024). In addition, globalization and digitalization trends have accelerated the distribution of food and beverage products through modern channels such as e-commerce and food delivery services (Vitsentzatou et al., 2022).

Another key driving factor is the continuous rise in consumer spending patterns, in line with improving income levels and purchasing power. Diverse product innovations whether in flavor, packaging, or added nutritional value also provide competitive advantages that keep this sector relevant and in demand (Vilas-Boas et al., 2022). The success of companies in adapting to market preferences and embracing trends such as functional and environmentally friendly foods further strengthens the position of this industry in the national economic landscape. The government also places special attention on this sector due to its significant contribution to Gross Domestic Product (GDP) and employment absorption (Tamin et al., 2024).

However, this promising growth is not without various challenges that business players in the food and beverage industry must face. Fluctuations in raw material prices such as sugar, oil, and wheat, much of which are still imported put pressure on production costs. Rising logistics costs, including transportation and distribution, further increase the risk of inefficiency (Adams et al., 2023). Moreover, global macroeconomic pressures such as inflation, currency depreciation,

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and international market uncertainties also affect business sustainability. Therefore, companies are required to adopt adaptive and innovative risk management strategies to maintain competitiveness and operational stability amidst uncertain dynamics (Suharyanto & Zaki, 2021).

One of the main challenges companies must anticipate is the potential for financial distress —a condition where a company experiences serious financial pressure that could lead to bankruptcy (Srebro et al., 2021). This condition not only affects the company's operational sustainability but can also reduce investor confidence and erode company value in the capital market (Hammond & Opoku, 2023). Therefore, early detection of financial distress is crucial so that management can take preventive actions before the situation worsens. An early warning system becomes a strategic tool to help stakeholders identify early symptoms of financial difficulties (Amarnath et al., 2023).

Amid the complexity of current corporate financial dynamics, conventional approaches that rely solely on financial ratio analysis are increasingly considered inadequate. Traditional methods have limitations in capturing non-linear and dynamic patterns of distress. In this context, digital technologies especially Machine Learning (ML) offer a more adaptive and advanced approach (Mentis et al., 2023). ML algorithms can process large amounts of historical data and identify hidden patterns that are not detected by conventional methods. Thus, the utilization of ML presents a promising solution to improve the accuracy of predicting potential financial distress (Malakauskas & Lakstutiene, 2021).

Artificial Intelligence (AI) and predictive analytics have transformed financial decision-making processes by enabling organizations to analyze large volumes of financial data efficiently (Mentis et al., 2023; Liu et al., 2025). In financial analytics, Machine Learning algorithms are increasingly utilized to identify hidden patterns, forecast risks, and support strategic decisions under uncertain business environments (Malakauskas & Lakstutiene, 2021). Compared to conventional statistical methods, Machine Learning approaches are capable of handling non-linear relationships and dynamic financial conditions more effectively (Barboza & Altman, 2024). Therefore, the integration of AI in financial distress prediction provides significant advantages in improving prediction accuracy and developing proactive financial risk management systems (Hassan et al., 2017).

This study uses PT Garudafood Putra Putri Jaya Tbk as a case study, considering that the company is a significant representative of Indonesia's fast-growing and competitive consumer goods sector (Brata & Putri, 2024). The company's quarterly financial reports from 2019 to 2024 are used as the basis for developing an ML-based prediction model. The aim of this research is to design a classification model capable of detecting financial distress more accurately and earlier. The output of this model is expected to contribute meaningfully to strategic decision-making for internal management, investors, and capital market regulators.

Previous studies have adopted Machine Learning algorithms in detecting financial distress using various methods such as Logistic Regression, Random Forest, and XGBoost. These algorithms are used to classify companies into healthy and distressed categories based on historical financial indicators. The results generally show that ML approaches can improve prediction accuracy compared to traditional ratio-based methods. Studies by Hassan et al, (2017) and Liu et al. (2025) for example, have demonstrated the effectiveness of ML models in identifying bankruptcy risks early, enabling faster and more informed decisions by management and investors.

However, most existing research remains focused on companies abroad or large-scale public entities with extensive and open financial data. In Indonesia, the use of Machine Learning to detect financial distress is still very limited, particularly in the consumer industry such as food and beverages. This is despite the fact that the sector plays a strategic role in the national economy, both in terms of GDP contribution and employment. This gap in the literature represents a critical opportunity to apply more advanced and contextual predictive approaches to support business sustainability and stability amid growing competition.

This research offers novelty by applying Machine Learning algorithms based on published secondary data particularly quarterly financial reports to develop an early warning system for potential financial distress in the food manufacturing sector. The focus on publicly available real-world data makes this approach not only replicable but also more practical for industry stakeholders. By leveraging the power of ML to detect non-linear patterns in financial data, this study contributes to creating a more accurate and adaptive prediction method in line with the fast-changing nature of business environments.

Unlike previous studies that tend to use cross-sector datasets or combine multiple companies in one model, this research specifically focuses on a single company, PT Garudafood Putra Putri Jaya Tbk. The single-case study approach allows for more in-depth and contextual analysis of the company's specific conditions and provides a more realistic picture of ML algorithm performance in an actual business setting. Moreover, the use of quarterly financial data allows the model to capture distress symptoms earlier and more responsively compared to annual data, which tends to be more aggregated and slower in reflecting financial changes.

There remains a significant gap in academic literature regarding the application of Machine Learning methods to quarterly financial data in Indonesia's consumer sector. Most studies still focus on annual or aggregated industry data, which tends to obscure the specific dynamics occurring in shorter time periods. In fact, a company's financial condition can change rapidly and fluctuate, especially in the food sector, which is heavily influenced by seasonality, raw material prices, and consumer trends (Spence, 2021). Therefore, the use of quarterly data in this

research serves as a particular strength in uncovering real-time distress potential.

Beyond the frequency of data, this research also contributes in terms of feature selection. Financial ratios such as liquidity, profitability, solvency, and activity ratios are used as the main variables in classification. Few studies have explicitly compared the effectiveness of these financial ratios in distress classification using real datasets from Indonesian companies. Through this approach, the study not only tests the performance of various ML algorithms in a local context but also opens opportunities for the development of more precise and data-driven financial monitoring systems for other companies in Indonesia's consumer sector.

This research provides a valuable contribution by developing an early detection model that can be used by company management, investors, and regulators to anticipate bankruptcy risk at an earlier stage. Additionally, the study enriches the academic literature on the application of Machine Learning in Indonesia's manufacturing sector through a transparent and verifiable approach based on publicly available secondary data.

The main goal of this research is to develop a predictive model based on Machine Learning algorithms to detect potential financial distress in PT Garudafood Putra Putri Jaya Tbk more accurately and efficiently. By utilizing publicly available quarterly financial data, this study aims to test the effectiveness of several algorithms such as Logistic Regression, Random Forest, Naive Bayes, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM) in classifying the company's financial condition into distress and non-distress categories based on key financial ratios. Furthermore, this research is intended to produce an early warning system that helps management identify early signs of financial difficulties, enabling faster intervention.

The implications of this research are relevant to various stakeholders. For PT Garudafood and similar food industry players, the research findings can serve as the foundation for developing an automated financial health monitoring tool, allowing management to proactively mitigate risk. For investors and financial analysts, the predictive model can serve as an additional reference in evaluating company performance and financial stability, especially for investment decision-making. Academically, the study contributes to the theoretical development of financial distress analysis using quarterly data and ML technology, while opening further avenues for exploration across other sectors and predictive models. For regulators and policymakers, the findings of this study can provide valuable insights for designing more responsive, data-driven supervision systems and risk mitigation policies particularly to safeguard the stability of strategic industrial sectors such as food and beverages.

However, previous studies on financial distress prediction have primarily focused on annual financial reports and cross-company datasets from developed countries. Limited studies have explored the use of quarterly financial reports in Indonesian manufacturing companies, particularly in the food and beverage sector. Furthermore, prior studies generally emphasize prediction accuracy without deeply examining the contribution of specific financial ratios in detecting early distress signals. Therefore, this study addresses this gap by utilizing quarterly financial reports and comparing multiple Machine Learning algorithms within a real-world Indonesian company context to develop a more responsive and adaptive early warning system.

This study is designed to answer several important research questions related to the implementation of Machine Learning algorithms in detecting financial distress at PT Garudafood Putra Putri Jaya Tbk. First, this research seeks to identify which Machine Learning algorithm provides the best predictive performance in classifying financial distress conditions. The algorithms evaluated in this study include Logistic Regression, Random Forest, Naive Bayes, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM). Second, the study aims to determine which financial ratios contribute the most to financial distress classification. Several financial indicators representing liquidity, profitability, solvency, and operational efficiency are analyzed to identify the most influential variables in detecting early financial problems. Third, this study examines the effectiveness of quarterly financial reports in improving the accuracy and responsiveness of financial distress prediction compared to conventional annual financial reporting approaches. Through these research questions, the study aims to develop a more adaptive and data-driven early warning system for financial risk management in Indonesia's food and beverage manufacturing sector.

This study assumes that financial ratios derived from quarterly financial reports contain significant patterns that can be utilized by Machine Learning algorithms to classify financial distress conditions accurately. Furthermore, ensemble learning methods such as Random Forest are expected to outperform traditional classification algorithms due to their capability to capture complex and non-linear relationships within financial data.

Figure 1. Conceptual Framework of Financial Distress Detection Using Machine Learning

Figure 1 illustrates the conceptual framework of this study. The process begins with quarterly financial data from PT Garudafood Putra Putri Jaya Tbk for the 2019–2024 period. The data undergo preprocessing and feature selection using the Chi-Square test before being analyzed using five Machine Learning algorithms: Logistic Regression, Random Forest, Naive Bayes, K-Nearest Neighbors, and Support Vector Machine. The best-performing model is then utilized to develop an early warning system for financial distress detection, which provides strategic benefits for management, investors, and regulators.

2. METHOD

This study adopts a quantitative approach with a case study design on PT Garudafood Putra Putri Jaya Tbk. The objective of this research is to develop an early warning system for potential financial distress by utilizing Machine Learning (ML) algorithms. The predictive model is developed and tested using the company's quarterly financial statements published from 2019 to 2024.

The data used in this study is secondary data obtained from the company's financial reports, including balance sheets and income statements. The dependent variable in this study is the financial condition of the company, which is classified into two categories: "distress" and "non-distress." The determination of financial distress status is based on indicators such as negative net income, consistent decline in retained earnings, and certain financial ratios that signal financial pressure, as adapted from the Altman Z-Score model. This study implements five Machine Learning algorithms as classification models.

Logistic regression is one of the most commonly used statistical algorithms for binary classification tasks, such as distinguishing between distress and non-distress conditions. Unlike linear regression which predicts continuous numerical values, logistic regression is used to predict the probability of an event occurring, with the final outcome classified into one of two classes: for instance, 1 (distress) and 0 (non-distress). In this study, logistic regression is used to model the relationship between the company's financial ratios (such as ROA, current ratio, debt-to-equity ratio, and others) and the likelihood of financial distress occurring (Sabek, 2023).

Random Forest is one of the most powerful and popular Machine Learning algorithms for both classification and regression tasks, including the detection of financial distress conditions in companies. Conceptually, Random Forest falls under the ensemble learning method category, which combines multiple learning models to produce more stable and accurate predictions. Specifically, Random Forest builds many decision trees randomly and then combines the prediction results from each tree to generate a final decision based on majority voting for classification or averaging for regression(Barboza & Altman, 2024).

Naive Bayes is a classification algorithm based on probability theory developed from Bayes' Theorem. This algorithm works by calculating the probability that a data point belongs to a particular class based on prior data. In the context of financial distress prediction, Naive Bayes calculates the likelihood that a company falls into the distress or non-distress category based on its financial ratios. For example, if a company has a high debt ratio and low return on assets, the algorithm will estimate the probability that it is experiencing financial distress based on historical data distribution (Rrmoku et al., 2022).

K-Nearest Neighbors (KNN) is a very simple yet effective classification algorithm, particularly when data is non-parametric and does not follow a specific distribution. The working principle of KNN is to classify data based on its proximity to a number of closest neighbors in the feature space. In practice, when a new data point is entered, the algorithm calculates its distance from all existing training data, then determines its class based on the majority class among the K nearest data points. In this study, KNN is used to classify companies into distress or non-distress categories based on financial ratios calculated from quarterly reports (Halder et al., 2024).

Support Vector Machine (SVM) is a powerful and highly effective classification algorithm, especially in cases where the decision boundary between two classes is not linearly separable. The primary goal of SVM is to find the optimal hyperplane that separates the two classes with the maximum margin. In the context of financial distress prediction, SVM attempts to map the company's financial ratios into a multidimensional space, then determine the optimal boundary that separates distressed and non-distressed companies (Valkenborg et al., 2023).

The selection of these algorithms is based on their proven effectiveness in previous studies related to distress prediction. The dataset is split into two parts: 80% for training and 20% for testing. The 80:20 train-test split was selected to provide a balanced proportion between model training and testing reliability, particularly considering the relatively limited dataset size.The performance of the models is evaluated using classification metrics including accuracy, precision, recall, and F1-score. To enhance the validity of the results, cross-validation techniques are applied during model testing.

This study implemented 5-fold cross-validation to improve model reliability and minimize overfitting risk. The dataset was divided into five subsets, where each subset was alternately used as testing data while the remaining subsets were used for training. Hyperparameter tuning was conducted to optimize model performance. For Random Forest, the number of estimators and maximum tree depth were adjusted. For KNN, the optimal number of neighbors was determined experimentally, while SVM optimization focused on kernel selection and regularization parameters.

Before model development, a series of data preprocessing steps are conducted, including normalization, handling of missing values, and outlier detection. Feature selection is performed through correlation analysis between variables to reduce multicollinearity and improve model efficiency. The financial ratios used in this study include liquidity ratios (e.g., current ratio), profitability ratios (ROA, ROE), solvency ratios (debt to equity ratio), and activity ratios (inventory turnover). All analytical processes are carried out using the Python programming language with libraries such as Scikit-learn, Pandas, NumPy, and Matplotlib.

3. RESULTS AND DISCUSSION

This study uses data obtained from the quarterly financial statements of PT Garudafood Putra Putri Jaya Tbk for the period 2019 to 2024. The financial reports used include the statement of financial position (balance sheet) and the income statement, which are then processed to generate several relevant financial indicators for detecting potential financial distress. This study specifically examines ten key financial ratios: Current Ratio, Quick Ratio, Debt to Equity Ratio (DER), Debt to Asset Ratio, Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin, Gross Profit Margin, Operating Profit Margin, and Interest Coverage Ratio. These ratios represent aspects of liquidity, solvency, profitability, and operational efficiency of the company.

The dependent variable in this study is the company's financial condition, which is classified into two categories: "distress" and "non-distress". The classification is based on conditions such as negative net income, consistent decline in retained earnings, and indications of financial pressure, adapted from the Altman Z-Score model. The data underwent several preprocessing stages, including normalization to equalize variable scales, handling of missing values, and outlier detection to avoid the influence of extreme data on prediction results.

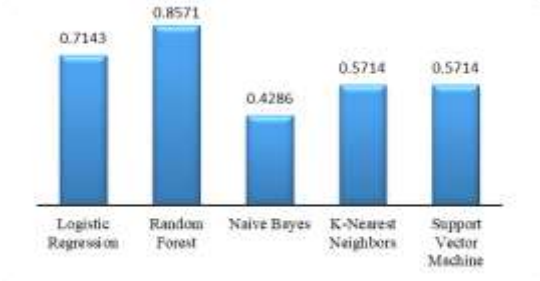

Figure 2. Train Data Accuracy
Source: Author's data processing (2026)

The objective of this study is to develop an early warning system to detect potential financial distress by utilizing five Machine Learning algorithms: Logistic Regression, Random Forest, Naive Bayes, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM). Based on the evaluation results, the Random Forest algorithm demonstrated the best performance with an accuracy of 85.71%, followed by Logistic Regression with 71.43%. Meanwhile, Naive Bayes achieved an accuracy of only 42.86%, and both KNN and SVM recorded accuracies of 57.14%. The evaluation was conducted using the quarterly financial data of PT Garudafood from 2019 to 2024, which had undergone preprocessing steps such as normalization, outlier detection, and feature selection using the Chi-Square test.

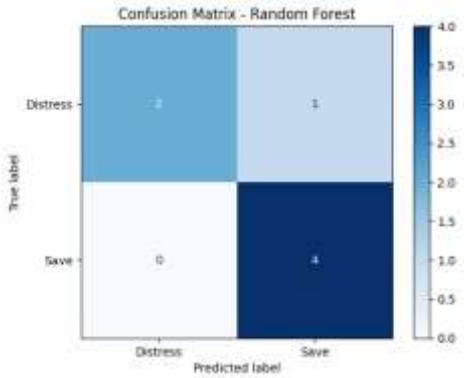

Figure 3. Confusion Matrix – Random Forest
Source: Author's data processing (2026)

The confusion matrix result from the Random Forest algorithm shows that this model can correctly classify companies in distress and accurately identify companies that are not in distress, with only one misclassification. Based on these results, the performance metrics for the distress class (as the positive class) show a precision of 100%, a recall of 66.67%, and an F1-score of 80%, which is the harmonic mean of precision and recall. For the non-distress class, the precision is 80%, the recall is 100%, and the F1-score is 88.89%.

These findings indicate that the Random Forest algorithm not only achieves a high overall accuracy but also successfully detects distress patterns with a high level of precision and sensitivity. With balanced performance between identifying distressed companies and maintaining a low error rate, this algorithm is a strong candidate to be implemented as an early warning system in the context of financial risk management, particularly in the food and beverage manufacturing sector.
The results are also consistent with previous studies such as those by Alaka et al. (2018) and Sun et al. (2020), which showed that Random Forest outperforms other algorithms in financial classification tasks, particularly in identifying companies under financial pressure. However, unlike some literature that reports strong SVM performance in financial prediction, this study found that SVM performed less effectively—likely due to the small dataset size and unoptimized kernel parameters. Therefore, this research reinforces evidence that Random Forest is the most reliable algorithm for predicting financial distress using quarterly financial data in the Indonesian context. Although Random Forest achieved the highest performance, the relatively small dataset may increase the risk of overfitting. The use of cross-validation techniques helped reduce this issue; however, future studies with larger datasets are recommended to improve model generalizability.

The accompanying bar chart illustrates the Chi-Square Score of each financial ratio used as an independent variable in this study. The Chi-Square values represent the contribution of each ratio in influencing the financial status of the company (distress or non-distress). The Operating Profit Margin and Debt to Asset Ratio show the highest scores 1.0036 and 1.0128 respectively indicating that they are the most significant indicators in detecting potential financial distress.

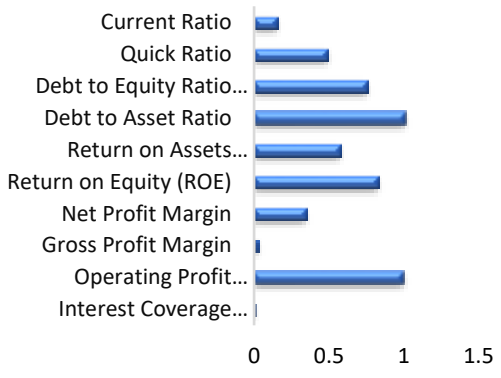

Figure 4. Contribution ratio
Source: Author's data processing (2026)

By observing the high Chi-Square scores for the Operating Profit Margin and Debt to Asset Ratio, it can be stated that a company's operational efficiency in generating profit from core activities, as well as its capital structure in relation to total assets, play a crucial role in determining its financial condition. These ratios are more effective in distinguishing companies experiencing financial distress from those in a healthy condition compared to other financial ratios. This finding highlights the importance for management to focus on operational efficiency and debt management in order to maintain the financial stability of the company.

This study has several limitations. First, the dataset only consists of quarterly financial reports from a single company, which may limit the generalizability of the findings. Second, the observation period from 2019 to 2024 may not fully capture long-term economic cycles. Third, external macroeconomic variables such as inflation and exchange rates were not included in the prediction model.

4. CONCLUSION AND SUGGESTIONS

Based on the research findings, it can be concluded that the application of Machine Learning algorithms has proven effective in detecting potential financial distress in the food and beverage sector, with a case study on PT Garudafood Putra Putri Jaya Tbk. This study utilized quarterly financial statement data from the period 2019 to 2024 and implemented five classification algorithms: Logistic Regression, Random Forest, Naive Bayes, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM). Among the five models tested, the Random Forest algorithm demonstrated the best performance, with an accuracy rate of 85.71%, a precision of 100% for the distress class, a recall of 66.67%, and an F1-score of 80%. These results indicate that Random Forest is capable of identifying financial distress symptoms with high sensitivity and precision, while maintaining balanced performance in distinguishing healthy and distressed companies.

These findings are further supported by feature testing using Chi-Square Scores, which show that financial ratios such as Operating Profit Margin and Debt to Asset Ratio contribute the most in distress classification. Additionally, the use of quarterly data has proven to provide better sensitivity and accuracy compared to annual data, making it highly relevant in the context of rapidly changing corporate financial dynamics. Therefore, this study recommends that companies, especially PT Garudafood and other similar firms in the food and beverage sector, begin developing early warning systems based on Machine Learning algorithms particularly using the Random Forest model. Such a system can be used to monitor financial indicators regularly and detect potential financial pressure early so that anticipatory actions can be taken promptly.

For future research, it is recommended to expand the dataset by including more companies from the same or different sectors and to extend the observation period so that the developed model has higher generalizability and is not limited to the characteristics of a single entity. Using data from various companies also opens up opportunities to build more robust and industry-applicable classification models. Moreover, a longer time frame allows for the observation of long-term financial trends, including the effects of seasonal factors, economic cycles, or government policies that may influence a company's financial condition.

REFERENCES

Adams, D., Donovan, J., & Topple, C. (2023). Sustainability in large food and beverage companies and their supply chains: An investigation into key drivers and barriers affecting sustainability strategies. *Business Strategy and the Environment*, *32*(4), 1451–1463. https://doi.org/10.1002/BSE.3198

Amarnath, G., Alahacoon, N., Attoh, E., Jampani, M., Panjwani, S., Ghosh, S., Amarasinghe, U., Musobani, L., Melele, V. C., Ng'andu, T., Ndiaye, O., Konte, O., Sal, N. A., & Gnanatheepan, W. (2023). *The early warning, early action, early finance (AWARE) platform - promoting early warning of and effective response to climate hazards.* International Water Management Institute (IWMI). CGIAR Initiative on Climate Resilience.

Barboza, F., & Altman, E. (2024). Predicting financial distress in Latin American companies: A comparative analysis of logistic regression and random forest models. *The North American Journal of Economics and Finance*, *72*, 102158. https://doi.org/10.1016/J.NAJEF.2024.102158

Brata, A., & Putri, A. (2024). Analisis Perusahaan PT Garuda Food Putra Putri Jaya Tbk. *Jurnal Syntax Admiration*, *5*(10), 3780–3793. https://doi.org/10.46799/JSA.V5I10.1524

Halder, R. K., Uddin, M. N., Uddin, M. A., Aryal, S., & Khraisat, A. (2024). Enhancing K-nearest neighbor algorithm: a comprehensive review and performance analysis of modifications. *Journal of Big Data 2024 11:1*, *11*(1), 1–55. https://doi.org/10.1186/S40537-024-00973-Y

Hammond, P., & Opoku, M. O. (2023). The mediating effect of going concern and corporate reporting in the relationship between corporate governance and investor confidence in financial institutions. *Heliyon*, *9*(10), e20447. https://doi.org/10.1016/j.heliyon.2023.e20447

Hassan, E. ul, Zainuddin, Z., & Nordin, S. (2017). A Review of Financial Distress Prediction Models: Logistic Regression and Multivariate Discriminant Analysis. *Indian-Pacific Journal of Accounting and Finance*, *1*(3), 13–23. https://doi.org/10.52962/IPJAF.2017.1.3.15

Liu, W., Suzuki, Y., & Du, S. (2025). Ensemble learning algorithms based on easyensemble sampling for financial distress prediction. *Annals of Operations Research*, *346*(3), 2141–2172. https://doi.org/10.1007/S10479-025-06494-Y/TABLES/11

Malakauskas, A., & Lakstutiene, A. (2021). Financial Distress Prediction for Small and Medium Enterprises Using Machine Learning Techniques. *Engineering Economics* , *32*(1), 4–14. https://doi.org/10.5755/J01.EE.32.1.27382

Mentis, A. F. A., Lee, D., & Roussos, P. (2023). Applications of artificial intelligence−machine learning for detection of stress: a critical overview. *Molecular Psychiatry 2023 29:6*, *29*(6), 1882–1894. https://doi.org/10.1038/s41380-023-02047-6

Nurhasan, M., Ariesta, D. L., Utami, M. M. H., Fahim, M., Aprillyana, N., Maulana, A. M., & Ickowitz, A. (2024). Dietary transitions in Indonesia: the case of urban, rural, and forested areas. *Food Security*, *16*(6), 1313–1331. https://doi.org/10.1007/S12571-024-01488-3/FIGURES/5

Rrmoku, K., Selimi, B., & Ahmedi, L. (2022). Application of Trust in Recommender Systems—Utilizing Naive Bayes Classifier. *Computation 2022, Vol. 10, Page 6*, *10*(1), 6. https://doi.org/10.3390/COMPUTATION10010006

Sabek, A. (2023). Unveiling the diverse efficacy of artificial neural networks and logistic regression: A comparative analysis in predicting financial distress. *Croatian Review of Economic, Business and Social Statistics*, *9*(1), 16–32. https://doi.org/10.2478/CREBSS-2023-0002

Setiawan, M., Effendi, N., Indiastuti, R., Fahmi, M., & Budiono. (2022). Innovation and Dynamic Productivity Growth in the Indonesian Food and Beverage Industry. *Resources 2022, Vol. 11, Page 98*, *11*(11), 98. https://doi.org/10.3390/RESOURCES11110098

Spence, C. (2021). Explaining seasonal patterns of food consumption. *International Journal of Gastronomy and Food Science*, *24*, 100332. https://doi.org/10.1016/J.IJGFS.2021.100332

Srebro, B., Mavrenski, B., Arsić, V. B., Knežević, S., Milašinović, M., & Travica, J. (2021). Bankruptcy Risk Prediction in Ensuring the Sustainable Operation of Agriculture Companies. *Sustainability 2021, Vol. 13, Page 7712*, *13*(14), 7712. https://doi.org/10.3390/SU13147712

Suharyanto, S., & Zaki, A. (2021). THE EFFECT OF INFLATION, INTEREST RATE, AND EXCHANGE RATE ON STOCK RETURNS IN FOOD & BEVERAGES COMPANIES. *Jurnal Aplikasi Manajemen*, *19*(3), 616–622. https://doi.org/10.21776/UB.JAM.2021.019.03.14

Tamin, J., Robiani, B., Teguh, M., & Mukhlis, M. (2024). Food And Beverage Industry Sector Linkages In Indonesia. *Equity: Jurnal Ekonomi*, *12*(1), 83–94. https://doi.org/10.33019/EQUITY.V12I1.284

Valkenborg, D., Rousseau, A. J., Geubbelmans, M., & Burzykowski, T. (2023). Support vector machines. *American Journal of Orthodontics and Dentofacial Orthopedics*, *164*(5), 754–757. https://doi.org/10.1016/j.ajodo.2023.08.003

Vilas-Boas, A. A., Magalhães, D., Campos, D. A., Porretta, S., Dellapina, G., Poli, G., Istanbullu, Y., Demir, S., San Martín, Á. M., García-Gómez, P., Mohammed, R. S., Ibrahim, F. M., El Habbasha, E. S., & Pintado, M. (2022). Innovative Processing Technologies to Develop a New Segment of Functional Citrus-Based Beverages: Current and Future Trends. *Foods 2022, Vol. 11, Page 3859*, *11*(23), 3859. https://doi.org/10.3390/FOODS11233859

Vitsentzatou, E., Tsoulfas, G. T., & Mihiotis, A. N. (2022). The Digital Transformation of the Marketing Mix in the Food and Beverage Service Supply Chain: A Grey DEMATEL Approach. *Sustainability 2022, Vol. 14, Page 15228*, *14*(22), 15228. https://doi.org/10.3390/SU142215228