

# Sustainable Performance Evaluation and Prediction of the Banking Sector: Opening the Black Box of DEA with Machine Learning and Explainable AI

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**Biography:** Dr. Yu Zhao is currently a Junior Associate Professor at the School of Management, Tokyo University of Science. He also serves as a visiting lecturer at the Institute of Statistical Mathematics, Japan. He obtained his Ph.D. in Information Science and Technology from Osaka University. His research primarily focuses on both the theoretical and practical aspects of statistical learning theory, operations research, and management science. His analytical approaches include machine learning and algorithmic learning methods, statistical inference and modeling, and mathematical programming, among others. His work has been published in journals such as *Omega – The International Journal of Management Science*, *The European Journal of Operational Research*, *Expert Systems with Applications*, and other reputable journals.

**Abstract:** Evaluating the efficiency of banking institutions is essential for understanding their operational effectiveness and competitiveness within the financial sector. Data Envelopment Analysis (DEA) serves as a non-parametric method to assess the relative efficiency of decision-making units based on multiple inputs and outputs, with the underlying production process considered as a black box. Complementarily, Machine Learning (ML) models offer predictive capabilities to forecast efficiency scores based on various financial and operational metrics, while Explainable AI (XAI) techniques further enhance the transparency and interpretability of the models. This study leverages a simulated dataset to integrate ML and XAI techniques with DEA, providing a robust framework that delves deeper into the structure of the black box for sustainable efficiency analysis and prediction in the banking industry.