# **Title**

"Predictive Data Analytics for Banking Marketing Success using Term Deposit Subscription Classification"

# **Topic Area**

Predictive Data Analysis, Banking, Telemarketing, Finance

# **Research Objectives**

* To develop and compare predictive models (Random Forest, XGBoost, CatBoost, CNN, and TabNet) for classifying term deposit subscriptions using direct marketing campaign data.
* To evaluate the performance of these models based on accuracy, precision, recall, F1-score, and computational efficiency.
* To analyse the most important features on model prediction.
* To determine which model offers the best balance between interpretability and predictive power.

# **Statement of Hypotheses**

* **H1**: Deep learning-based models (CNN, TabNet) will outperform traditional ensemble methods (Random Forest, XGBoost, CatBoost) in predicting term deposit subscriptions, particularly in handling complex feature interactions.
* **H2**: Ensemble models (XGBoost, CatBoost) will provide higher interpretability and generalisability compared to deep learning models, making them more suitable for business use cases where transparency is important.

# **Literature Review**

## **Predictive Analytics in Banking**

Broby (2022) takes a closer look at the use of these techniques in the financial industry where classification, regression, clustering and time series are discussed. The study incorporates these techniques into Decision Support System (DSS), which assists the financial managers in their decisions making. More than 187 papers are inspected according to the proposed SPAR-4-SLR protocol; and despite the fact that the range includes many algorithms, it is dominated by Random Forests, Support Vector Machines (SVM), and Neural Networks. For instance, Huang et al. (2005) employed SVM to anticipate the overall direction of stock at 75%accuracy; Broby (2022). These methods are used in the determination of the financial future position and in the framework of risk management plans.

In the present study, Moinuddin et al. (2024) analyse the effect of the marketing analytics on the consumers and the campaign effectiveness using both discussed interviews and surveys. This research also finds out that checking of analytics tools is done weekly by 75% of the respondents, the mean score the respondents gave to the increase in the success of their campaigns as a result of this activity was 8.5 out of 10. Correlation analysis gave a value of 0.75 on the Pearson coefficient and this suggested that analytics usage had directly dependent on the campaign evaluation (Moinuddin et al., 2024/). This is particularly important in current society, yet to show why there is a need to shift towards data driven marketing.

Zaki et al, (2024) analyse predictive analytics and machine learning in term deposit subscriptions of the bank using models like SGD, KNN, and Random Forest. Feature engineering, cross tabulation, and heatmaps were used during data exploration conducted in the study. Random Forest model performed better than other models where accuracy was found to be 87 %, PPV = 87.83% and NPV = 92.99%. These findings offer relevant tips that can be used to improve advertising tactics in banking (Zaki et al., 2024).

Amajuoyi et al. (2024) study the impact of analytics models for customer retention and business growth. Based on the obtained data of the contacts’ database and machine learning algorithms, they define high and low potential clients and churn threats. According to the study it indicates that the businesses that adopt the actions of predictive analytics experienced a customer retention level of 25% and the efficiency of an expanding market of 30%. The study maps to how machine learning advances targeted customer marketing and interaction (Amajuoyi et al., 2024).

In finance, Olaniyi et al. (2023) consider how predictive analytics shifts data into a form that gives insight. The authors discuss and evaluate various decision approaches including decision tree, random forest, and neural network to show that the predictive models yield the result of 40 percent increase in resource efficiency for financial institutions. The research also focuses on the PWE’s key significance for risk management and fraud prevention; effectiveness enhancement up to 30%, in the essential financial risk situations (Olaniyi et al., 2023).

Most recent work on decision trees for predictive analytics of business decisions include Lee et al. 2022. The study used secondary research where more than twenty four papers have been reviewed from fields as; healthcare, finance and customer relationship. This was especially interesting because the decision tree showed marked improvement of 30% in customer behaviour predictability in relation to their customer retention. Concisely, the authors shall find that although relatively basic and very easy to comprehend, the decision trees are still the valuable instruments for the predictive business analytics (Lee et al., 2022).

Authors Wassouf et al. (2020) implement a big data framework for predicting customer loyalty for the Syriatel Telecom. They used two main components of the TFM model in combination with usage and demographic data of customers to categorise customer loyalty. Among the four machine learning models tested: Random Forest; Decision Tree; Gradient-Boosted Trees; and Multilayer Perceptron. The highest accuracy achieved in binary classification based on the results of the Gradient-Boosted Trees is 87%. This paper also reveals how big data analytics can promote customer loyalty more than it has already been estimated (Wassouf et al., 2020).

Zulaikha et al. (2020) look into how the integration of artificial intelligence in marketing can shape the way customer predictive analytics. By applying various algorithms, the study’s customer data on behaviour and demographic characteristics are segmented and targeted. The authors also note that companies adapting AI within the scheme for customer segmentation saved 25% of the targeting effect and reduced their marketing expenses by 30%. This paper therefore emphasises on the feasibility of the AI based segmentation in improving marketing effectiveness and consumer satisfaction (Zulaikha et al., 2020).