Portuguese Bank Marketing Analysis – Summary Report

1. Objective

This project aims to analyze the Portuguese Bank Marketing dataset and build predictive machine learning models to identify customers likely to subscribe to a term deposit. The workflow includes exploratory data analysis, preprocessing, model development, and evaluation.

2. Dataset Description

The dataset contains demographic details, marketing campaign information, and economic indicators. The target variable represents whether a customer subscribed to a term deposit. The data is highly imbalanced, with significantly fewer positive subscriptions.

3. Exploratory Data Analysis (EDA)

1   Customer age distribution showed higher engagement in middle-aged groups.

2   Call duration had the strongest impact on subscription success.

3   Higher subscription rates were observed in specific months and job categories.

4   Repeated contact attempts reduced the likelihood of a positive response.

4. Data Preprocessing

1   Handled missing and 'unknown' categorical values.

2   Encoded categorical variables into numerical formats.

3   Scaled numerical features where required.

4   Split the dataset into training and testing sets.

5. Model Building

1   Logistic Regression served as the baseline model.

2   Naive Bayes achieved high recall but low precision.

3   K-Nearest Neighbors showed average performance.

4   Support Vector Machine struggled due to class imbalance.

5   Random Forest produced the best overall results.

6. Model Evaluation

Models were evaluated using accuracy, precision, recall, F1-score, and confusion matrices. Threshold tuning was applied to improve performance. Random Forest achieved the best balance between recall and precision, making it suitable for deployment.

7. Final Conclusion

The analysis demonstrates that targeted, well-timed, and personalized marketing strategies significantly improve subscription rates. Machine learning models can effectively support decision-making when combined with human-centric campaign planning.