Strategic Banking Optimization

Predicting Term Deposit Subscriptions with Machine Learning

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EXECUTIVE SUMMARY (PACE Framework)

This project optimizes bank marketing outreach by predicting customer propensity to subscribe to term deposits. Using a dataset of 1 million records, we developed a machine learning solution that moves from mass outreach to a data-driven prioritization strategy, significantly improving marketing ROI.

P - Plan: The Business Challenge

- Objective: Reduce marketing overhead and increase term deposit conversion rates.
- Baseline: Traditional outreach strategies yield a ~12% conversion rate, resulting in high cost-per-acquisition (CPA).
- Target: Identify the most likely subscribers before the campaign begins to optimize sales team resources.

A - Analyze: Data Strategy & Integrity

- Scope: 1,000,000 customer records (750,000 train / 250,000 test).
- Governance: Removed the 'duration' column (call length) to prevent data leakage, ensuring the model is deployable for pre-campaign prediction.
- Feature Engineering: Processed 42 encoded features including demographics and account history.
- Key Findings: Account balance and age were identified as primary drivers of subscription likelihood.

C - Construct: Technical Implementation

- Algorithm: Random Forest Classifier (random_state=0, class_weight='balanced').
- Parameters: Optimized via GridSearchCV (n_estimators: 300, 500; max_samples: 0.7, 1.0; max_features: 1.0).
- Imbalance Strategy: Used 'balanced' class weights to accurately detect the minority class (subscribers).

E - Execute: Strategic Impact

- Results: Achieved a Validation ROC-AUC of 0.84, significantly outperforming baseline logistic regression (0.78).
- Strategic Value: Precision improved from 12% (random) to 45% (model-driven top decile).

- Efficiency Gains: Potential to reduce outreach costs by up to ~70% under specific targeting assumptions and threshold optimization.
- Recommendation: Move from 'Random Dialing' to 'Propensity-Based Dialing' via CRM integration.

Top Feature Importance Drivers

Feature	Importance Weight
Account Balance	0.266
Customer Age	0.120
Day of Month	0.102
Contact Method (Unknown)	0.070
Campaign Frequency	0.058
Previous Campaign Success	0.045
Housing Loan Status	0.045

Conclusion

This project illustrates the transition from descriptive reporting to predictive strategy. By focusing on pre-call data points and rigorous leakage prevention, the solution provides a realistic, production-ready tool for optimizing banking marketing campaigns.