SCENARIO EXERCISE

The importance of data quality in AI-targeted marketing campaigns

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Abstract

Type of OER:

- Scenario Exercise

Goal/Purpose:

- Raise awareness about the importance of data quality for implementing automated decision making algorithms (ADMS), particularly in the marketing sector.

Expected Learning Outcomes:

- The student will be able to implement measures to address bias in customer behaviour predictions.

Suggested Methodological Approach (Case-Based Learning, Problem-Based Learning...):

- Problem-based learning

Keywords:

- Data quality, biased algorithms, unbalanced data, marketing campaigns, ADMS.

Introduction

Introduction

Context: predicting bank marketing success using machine learning.

- The dataset used in this project is the Bank Marketing Dataset from the UCI Machine Learning Repository. It contains details about clients contacted in a marketing campaign and whether they subscribed to a term deposit.
- Dataset Description: Bank Marketing Dataset – UCI (bank.csv included in the OER materials).
- Read carefully each variable and understand its meaning.

Key Problem Statement

- How can we predict whether a client will subscribe to a term deposit based on their profile and past campaign interactions?
- **Challenge**: The dataset is highly imbalanced, with far fewer clients subscribing to a deposit, leading to potential bias in the model.

Tools presentation

Tools used in this scenario exercise

- **Python**: the most used programming language in Data Science
- **A python editor**: Google Colab or Jupyter Notebook
- **Libraries and Frameworks**
  - Pandas: data manipulation and cleaning
  - Scikit-learn: model training, evaluation, and data preprocessing
  - XGBoost: optimized gradient boosting framework
  - imbalanced-learn (SMOTE): to address class imbalance issues
  - Matplotlib/Seaborn: visualization and data insights
- **Techniques Applied**
  - Data Cleaning & Feature Engineering
  - Handling Class Imbalance (SMOTE, Undersampling, Class Weights)
  - Model Training (RandomForest, XGBoost)
  - Performance Evaluation (Recall, Precision, and F1-score)

Hands-on activities

Solution Description (follow the provided notebook)

DATA PREPROCESSING

- Removed variables such as duration, campaign, and pdays that are only known after contacting clients to avoid data leakage.
- Encoded categorical variables and scaled numerical data for better model performance.

HANDLING CLASS IMBALANCE

Applied:

- Class Weights in RandomForest to penalize errors on the minority class.
- SMOTE (Synthetic Minority Over-sampling Technique) to artificially increase samples in the minority class.
- Undersampling to reduce the size of the majority class.

MODEL TRAINING

Tested multiple models:

- RandomForest for baseline prediction.
- XGBoost for improved performance, optimized with Early Stopping and Feature Selection to reduce training time.

EVALUATION

Evaluated results using:

- Recall for minority class detection.
- F1-Score for balanced accuracy between precision and recall.

Conclusion

Conclusion

Key Insights

- Bias in Data matters: the imbalance in the dataset led initial models to ignore the minority class (clients subscribing to deposits).
- Balancing Techniques are key: undersampling, Class Weights, and SMOTE improved recall significantly, albeit with trade-offs in overall accuracy.
- XGBoost with Feature Selection: by reducing the number of features and adding early stopping, XGBoost improved performance without compromising efficiency.

Key Lesson

- Ethical AI design requires thoughtful dataset preparation, fair evaluation metrics, and awareness of potential bias in outcomes.

References

References

- Bank Marketing Dataset - UCI Machine Learning Repository: https://archive.ics.uci.edu/dataset/222/bank+marketing
- Scikit-learn Documentation: https://scikit-learn.org/
- XGBoost Documentation: https://xgboost.readthedocs.io/en/stable/
- Imbalanced-learn Documentation: https://imbalanced-learn.org/

Complementary material

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Jupyter Notebook (IPYNB) File

- A detailed Python Notebook with commented code that walks through each step of the process is included.
- The notebook contains:
  - Data cleaning and preprocessing steps.
  - Feature engineering and variable selection logic.
  - Implementation of different balancing techniques (SMOTE, Class Weights, and Undersampling).
  - Model training with RandomForest and XGBoost.
  - Evaluation metrics and insights from the results.

As a technologist, I see how AI and the fourth industrial revolution will impact every aspect of people's lives.

Fei Fei Li

leaders

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