Non-Technical Loss Detection in Electric Meter Systems: A Predictive Approach with Business Intelligence in North Lima

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Abstract:

Non-technical losses (NTL) in power distribution systems, including electricity theft, device failures, and maintenance issues, represent a significant challenge for electric utility companies, especially in emerging economies. This study presents a predictive model that uses advanced business intelligence (BI) and machine learning techniques, specifically ARIMA and XGBoost models, to detect non-technical losses in electric metering systems in northern Lima. The methodology employed includes data extraction, transformation, and loading (ETL) from various sources, such as the National Open Data Platform and electric utility registries. After a series of preprocessing steps involving anomaly detection, feature engineering, and cross-validation, the model optimizes its accuracy in predicting irregular consumption patterns, energy theft indicators, and other NTL. The results obtained demonstrate that the combination of ARIMA and XGBoost is effective in identifying atypical consumption patterns, contributing to improving both the reliability of the electric system and its economic efficiency. Furthermore, the model respects data governance policies under Legislative Decree 1412, ensuring quality and security of information. The solution is scalable and can be adapted to other similar contexts, offering a useful tool for energy distribution companies in the early detection of consumption irregularities. Thus, it presents an effective alternative to reduce non-technical losses through advanced analysis, improving energy management in areas with distribution challenges.