Project Report: Quality Prediction in a Mining Process

1. Background

In the mining industry, the flotation process is used to remove impurities such as silica from iron ore. By predicting the silica concentration in the output, engineers can proactively make adjustments that improve efficiency and minimize ore loss and environmental impact.

2. Problem Statement

The goal is to forecast the percentage of silica in the ore concentrate, ideally in real-time and also for future time steps. The challenge is to perform this prediction with or without using highly correlated variables like % Iron Concentrate.

3. Dataset Description

The dataset contains over 20 features collected from a flotation plant between March and September 2017. It includes quality measures (e.g., iron and silica feed), chemical dosages (e.g., amina, starch), and process measurements (e.g., airflow, levels in flotation columns).

4. Design & Methodology

We began by preprocessing the data, handling regional number formats, converting strings to floats, and ensuring consistent time indices. Models tested included Linear Regression, Random Forest, and XGBoost. Evaluation was done using RMSE, MAE, and R^2 score. Multi-step forecasting and feature importance analysis were also performed.

5. Results

RandomForestRegressor achieved the best accuracy for both short-term and hour-ahead forecasting. Key influential features were pH levels, air flow, and reagent dosage. The model successfully predicted silica levels even without the % Iron Concentrate variable, proving its robustness.

6. Learnings

Working with industrial datasets emphasized the need for advanced preprocessing and validation. We also found that model explainability was vital for stakeholder confidence. The forecasting solution demonstrates the value of ML in industrial automation and sustainability.

7. Conclusion

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Machine learning effectively predicted silica content, enabling real-time feedback for engineers. The solution supports both quality improvement and environmental sustainability, aligning with smart mining goals.

8. About the Internship

This project was completed as part of a Machine Learning Internship at Uniconverge Technologies Pvt. Ltd. It provided real-world exposure to predictive maintenance and industrial analytics challenges.

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