Restaurant-Level Food Waste Prediction and Reduction using Machine Learning

Abstract:

Food waste poses a significant operational and environmental challenge within the food service industry. This project proposes a machine learning-based system designed to predict food waste based on operational and contextual data. A Random Forest regression model is trained to estimate food waste and provide actionable recommendations to mitigate wastage. An interactive Streamlit application is also developed for real-time predictions.

Problem Statement:

Restaurants and event organisers frequently overestimate food demand, resulting in excessive food waste. Manual estimation methods are inefficient and prone to inaccuracies.

Objectives:

* Predict food waste quantity
* Identify key influencing factors
* Provide actionable recommendations
* Develop an end-to-end machine learning system

Dataset Description:

The dataset comprises event-level food preparation details, including the number of guests, quantity prepared, food type, event type, pricing, storage conditions, and seasonality.

Methodology:

***** Data preprocessing
* Exploratory data analysis (EDA)
* Feature engineering
* Training of a Random Forest model
* Evaluation using Mean Absolute Error (MAE) and R^2 score
* Explainability via feature importance analysis
* Deployment using Streamlit

Model and Evaluation:

The Random Forest Regressor demonstrated robust predictive performance, characterised by low MAE and a high R^2 score.

Explainability:

Feature importance analysis revealed that the number of guests and quantity prepared are the most significant contributors to food waste.

Conclusion:

The system effectively predicts food waste and facilitates decision-making to reduce wastage, thereby enhancing operational efficiency and sustainability.

Future Scope:

***** Integration with point-of-sale (POS) systems
* Real-time forecasting
* NGO donation linkage