**Data Preparation**

1. **Loading and Cleaning Data:**
   * Relevant columns are filtered from raw data.
   * Missing or invalid values in important columns are handled (e.g., DO levels, time).
   * Combined date and time information into a single Date\_Time column, rounded to the nearest hour.
   * Rows with invalid or test data are excluded.
2. **Feature Engineering:**
   * A new column, In\_Required\_Range, is created to classify whether a DO level is within the specified range for morning or evening.
   * A shifted version of this column (Prev\_In\_Required\_Range) represents the previous measurement's status to establish trends.

**Analysis and Feature Selection**

1. **Correlation Analysis:**
   * Weather variables (e.g., temperature, humidity) are correlated with DO levels for each pond.
   * The correlations are visualized and saved for further analysis.

**Model Training**

1. **Defining Features and Target:**
   * Features include weather variables and other pond-related metrics.
   * The target variable (OOR) indicates whether the current DO measurement is out of the desired range.
2. **Training and Validation:**
   * Data is split into training and testing sets.
   * A Random Forest classifier is trained to predict OOR.
3. **Evaluation:**
   * The model is evaluated using metrics such as accuracy, precision, recall, and F1 score.
   * Feature importance is computed and visualized to identify the most influential factors.

**Prediction and Visualization**

1. **Risk Assessment:**
   * Predictions on the likelihood of DO levels being out of range are made.
   * A threshold is used to classify high vs. low risk of OOR.
2. **Interactive Visualization:**
   * Time-series plots of morning and evening DO levels and the probability of OOR are created for each pond.
   * Dropdown menus allow toggling between ponds, and shaded regions mark acceptable DO ranges.

**Outputs**

* A CSV file (DO\_OOR\_Predictions\_V2.csv) contains the risk assessments and predictions.
* Visualizations and plots help interpret trends and model results.