WATER QUALITY ANALYSIS

BATCH MEMBER

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Phase 4 Submission Document

Project Title: Water Quality Analysis

Phase4: ***Development part 2***

Topic: Continue analysing the water quality by feature engineering, model training and evaluation

WATER QUALITY ANALYSIS

Introduction:

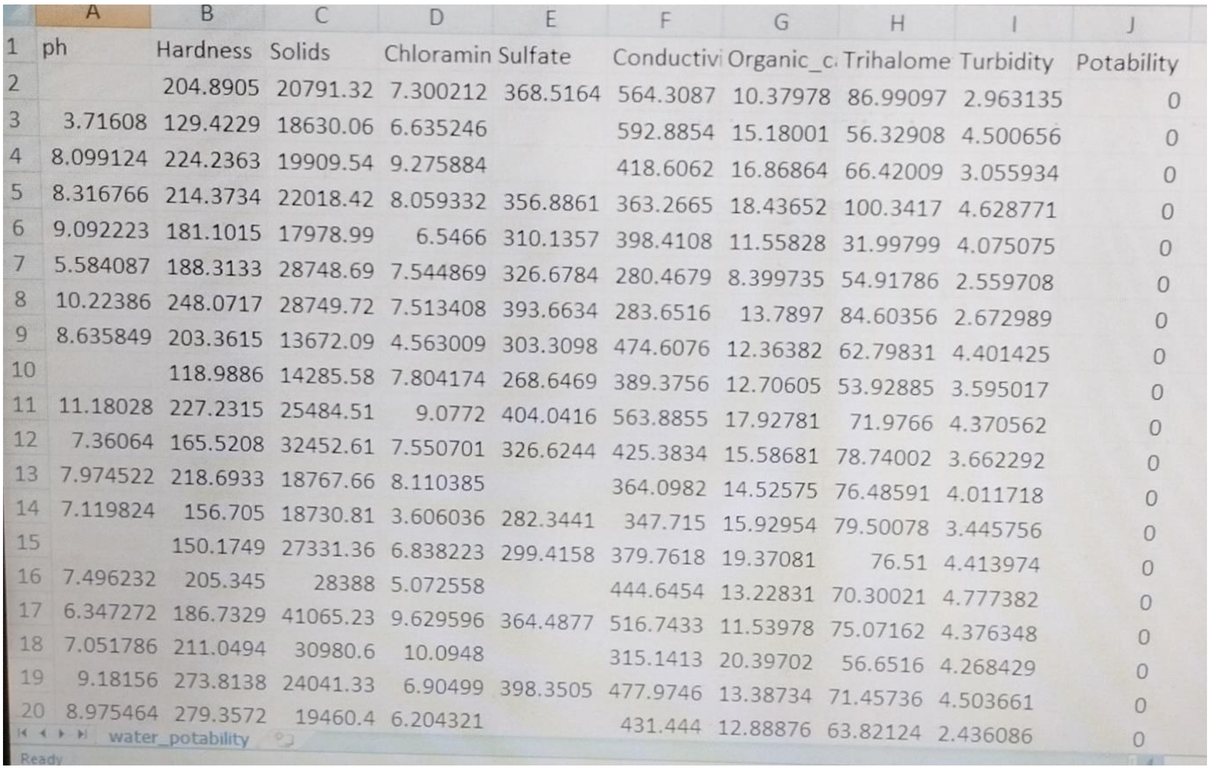
1. To measure concentration of the constituents in quantity for characterisation of water for different uses .

2.Of the various parameters in potable water few are objectionable even when present in very small quantity.

3. Others if only present in unusual quantities as to relegate the water from the potable to the unusable class.

4. The analyst familiar with water quality characterisation will often select parameters to be measured based on experience and intuition.

Given dataset:



	A	B	C	D	E	F	G	H	I	J
1	ph	Hardness	Solids	Chloramin	Sulfate	Conductivi	Organic_c	Trihalome	Turbidity	Potability
2		204.8905	20791.32	7.300212	368.5164	564.3087	10.37978	86.99097	2.963135	0
3	3.71608	129.4229	18630.06	6.635246		592.8854	15.18001	56.32908	4.500656	0
4	8.099124	224.2363	19909.54	9.275884		418.6062	16.86864	66.42009	3.055934	0
5	8.316766	214.3734	22018.42	8.059332	356.8861	363.2665	18.43652	100.3417	4.628771	0
6	9.092223	181.1015	17978.99	6.5466	310.1357	398.4108	11.55828	31.99799	4.075075	0
7	5.584087	188.3133	28748.69	7.544869	326.6784	280.4679	8.399735	54.91786	2.559708	0
8	10.22386	248.0717	28749.72	7.513408	393.6634	283.6516	13.7897	84.60356	2.672989	0
9	8.635849	203.3615	13672.09	4.563009	303.3098	474.6076	12.36382	62.79831	4.401425	0
10		118.9886	14285.58	7.804174	268.6469	389.3756	12.70605	53.92885	3.595017	0
11	11.18028	227.2315	25484.51	9.0772	404.0416	563.8855	17.92781	71.9766	4.370562	0
12	7.36064	165.5208	32452.61	7.550701	326.6244	425.3834	15.58681	78.74002	3.662292	0
13	7.974522	218.6933	18767.66	8.110385		364.0982	14.52575	76.48591	4.011718	0
14	7.119824	156.705	18730.81	3.606036	282.3441	347.715	15.92954	79.50078	3.445756	0
15		150.1749	27331.36	6.838223	299.4158	379.7618	19.37081	76.51	4.413974	0
16	7.496232	205.345	28388	5.072558		444.6454	13.22831	70.30021	4.777382	0
17	6.347272	186.7329	41065.23	9.629596	364.4877	516.7433	11.53978	75.07162	4.376348	0
18	7.051786	211.0494	30980.6	10.0948		315.1413	20.39702	56.6516	4.268429	0
19	9.18156	273.8138	24041.33	6.90499	398.3505	477.9746	13.38734	71.45736	4.503661	0
20	8.975464	279.3572	19460.4	6.204321		431.444	12.88876	63.82124	2.436086	0

water_potability

Ready

3277 rows*7 columns

Overview of the process:

1. Sample Collection:

- Select sampling sites that represent the area of interest.
- Use clean containers and equipment to collect water samples.
- Ensure proper labelling and documentation of sample location and time.

2. Preservation:

- Some samples may require immediate analysis, while others may need preservation to prevent changes in their properties. Common preservation methods include cooling, acidification, or adding specific chemicals.

3.Pre-processing:

- Filtration: Remove particulate matter using filters to obtain a clear liquid sample.
- Homogenization: Mix the sample to ensure a representative composition.

Physical Parameters Analysis:

- Temperature: Measure water temperature using a thermometer or a sensor.
- pH: Determine the acidity or alkalinity of the water with a pH meter.
- Turbidity: Assess water cloudiness or clarity using a turbid meter.

Chemical Parameters Analysis:

- Dissolved Oxygen (DO): Measure the concentration of oxygen in the water.
- Conductivity: Assess water's ability to conduct electrical current.
- Nutrients (e.g., nitrates, phosphates): Analyze the levels of essential nutrients.
- Heavy Metals: Test for the presence of potentially toxic elements like lead, mercury, and cadmium.
- Organic Contaminants: Detect organic compounds, such as pesticides or hydrocarbons.

Biological Parameters Analysis:

- Bacterial Analysis: Assess the presence of coli form bacteria or pathogens.
- Algal and Phytoplankton Analysis: Identify and quantify microscopic organisms.
- Macro invertebrates: Study aquatic insects, worms, and other macro invertebrates as indicators of water quality.

Data Interpretation:

- Compare the results to water quality standards, guidelines, or regulatory limits.
- Assess the implications for human health, aquatic ecosystems, and intended water uses.

Reporting:

- Prepare a detailed report summarizing the findings, methods used, and conclusions.
- Share the results with relevant authorities, stakeholders, or the public.

Procedure:

This test uses liquid reagent and a colour comparator. Dissolved Oxygen (DO): A measure of the amount of oxygen dissolved in water. This test uses a two-step procedure. In the first step, the sample is "fixed"; in the second, it is titrated to determine the level of DO in parts per million (ppm).

Feature selection:

```
class WaterQualityAnalyzer:
    def _init_(self):
        self.pH = 7.0  # Placeholder pH value
        self.dissolved_oxygen = 6.0  # Placeholder dissolved oxygen value
        self.turbidity = 2.0  # Placeholder turbidity value
        self.temperature = 25.0  # Placeholder temperature value
```

```
    def collect_data(self):
        # In a real application, you would collect data from sensors.
        # For this example, we'll use random values.
        import random
        self.pH = random.uniform(6.5, 8.5)
        self.dissolved_oxygen = random.uniform(4.0, 10.0)
        self.turbidity = random.uniform(0.0, 5.0)
        self.temperature = random.uniform(20.0, 30.0)

    def analyze(self):
        # Perform water quality analysis based on collected data.
        if 6.5 <= self.pH <= 8.5:
            pH_status = "Optimal"
        else:
            pH_status = "Suboptimal"

        if 5.0 <= self.dissolved_oxygen <= 9.0:
            oxygen_status = "Optimal"
        else:
            oxygen_status = "Suboptimal"

        if self.turbidity <= 2.0:
            turbidity_status = "Optimal"
        else:
            turbidity_status = "Suboptimal"

        return {
            "pH": self.pH,
            "pH_status": pH_status,
            "Dissolved Oxygen (mg/L)": self.dissolved_oxygen,
            "Dissolved Oxygen_status": oxygen_status,
            "Turbidity (NTU)": self.turbidity,
            "Turbidity_status": turbidity_status,
            "Temperature (°C)": self.temperature,
        }

if _name_ == "_main_":
```

```
analyzer = WaterQualityAnalyzer()
analyzer.collect_data()
result = analyzer.analyze()

print ("Water Quality Analysis Results:")
For key, value in result.items():
    print (f"{key}: {value}")
```

Model training:

1. **Data Collection**:
Gather a comprehensive dataset of water quality measurements. This dataset should include various parameters such as pH, turbidity, dissolved oxygen, temperature, nutrient levels, and pollutants. Make sure the data is representative of the conditions you want to analyze.

2. **Data Pre-processing**:
Clean the data by handling missing values, outliers, and inconsistencies. Normalize or standardize the data to ensure that all parameters have the same scale, which is crucial for many machine learning algorithms.

Feature Selection: Identify the most relevant features (parameters) for your analysis. Some parameters may have more influence on water quality than others. Feature selection techniques can help you choose the most important variables.

3**. Model Selection**:
Choose an appropriate machine learning or statistical model for your analysis. Common models for water quality analysis include regression models (e.g., linear regression), decision trees, random forests, or deep learning models like neural networks.

4**. Training the Model**:
Split your dataset into a training set and a testing set to train and evaluate your model. Train the model using the training data, and tune hyper parameters to improve performance.

5. **Model Evaluation**:

Use metrics like Mean Absolute Error, Root Mean Squared Error, or others depending on the specific goals of your analysis to evaluate the model's performance. Cross-validation can help assess how well the model generalizes to new data.

6**. Interpretability**:
If your analysis requires understanding the factors influencing water quality, consider using interpretable models or techniques to explain the model's predictions. Explainable AI can be valuable in this context.

7**. Deployment**:
Once you have a trained and validated model, deploy it for real-world applications. This might involve integrating it into a monitoring system, a mobile app, or a web platform to provide real-time or periodic water quality predictions or alerts.

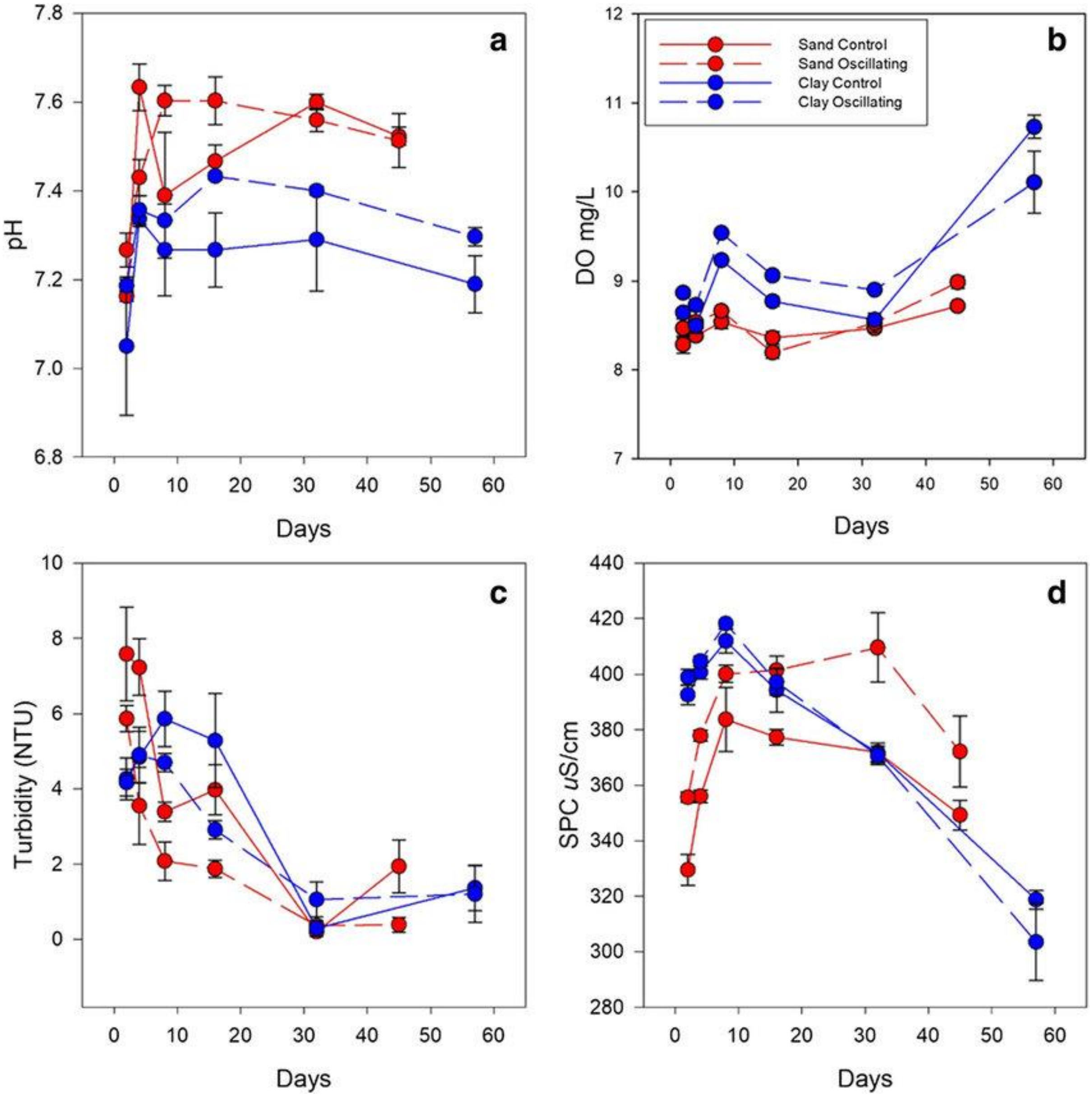
8. **Continuous Improvement**:
Regularly update and retrain the model as new data becomes available to ensure that it remains accurate and relevant.

Compliance and Regulations: Ensure that your model and its predictions comply with local and national water quality regulations and standards.

Remember that the success of your model depends on the quality of your data, the choice of the appropriate features, and the selection of a suitable machine learning algorithm. It's also essential to involve domain experts who understand water quality to guide the process and interpret the results effectively.

Program Output:

pH: 7.230141217189239
pH_status: Optimal
Dissolved Oxygen (mg/L): 8.27849742613547
Dissolved Oxygen status: Optimal
Turbidity (NTU): 3.421739774856105
Turbidity status: Suboptimal
Temperature (°C): 26.589718561447264"



Feature Engineering:

Feature engineering is a crucial aspect of water quality analysis, enabling the extraction of valuable insights from raw data. This process involves the creation of relevant features to better understand and model water quality parameters. Various techniques can be employed, including temporal features like hourly or seasonal averages, statistical measures to capture data distribution, and the calculation of lag variables or moving averages to identify trends and autocorrelations. Interaction features that explore relationships between different parameters, categorical encoding for location data and the incorporation of domain-specific information such as weather or land use can all enhance the analysis. Seasonal decomposition, frequency analysis, and time series features.