Predicting Air Quality Levels using ML

Google Colab Notebook – Step by Step

In [ ]:
```
# Step 1: Upload the dataset
from google.colab import files
uploaded = files.upload()
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving Air_Quality.csv to Air_Quality.csv
```

In [ ]:
```
# Step 2: Load the dataset
import pandas as pd
df = pd.read_csv('Air_Quality.csv')
df.head()
```

Out[ ]:

	Unique ID	Indicator ID	Name	Measure	Measure Info	Geo Type Name	Geo Join ID	Geo Place Name	Time Period
0	336867	375	Nitrogen dioxide (NO2)	Mean	ppb	CD	407	Flushing and Whitestone (CD7)	Winter 2014-15
1	336741	375	Nitrogen dioxide (NO2)	Mean	ppb	CD	107	Upper West Side (CD7)	Winter 2014-15
2	550157	375	Nitrogen dioxide (NO2)	Mean	ppb	CD	414	Rockaway and Broad Channel (CD14)	Annual Average 2017
3	412802	375	Nitrogen dioxide (NO2)	Mean	ppb	CD	407	Flushing and Whitestone (CD7)	Winter 2015-16
4	412803	375	Nitrogen dioxide (NO2)	Mean	ppb	CD	407	Flushing and Whitestone (CD7)	Summer 2016

In [ ]:
```
# Step 3: Data Exploration
df.info()
df.describe()
df.columns
```

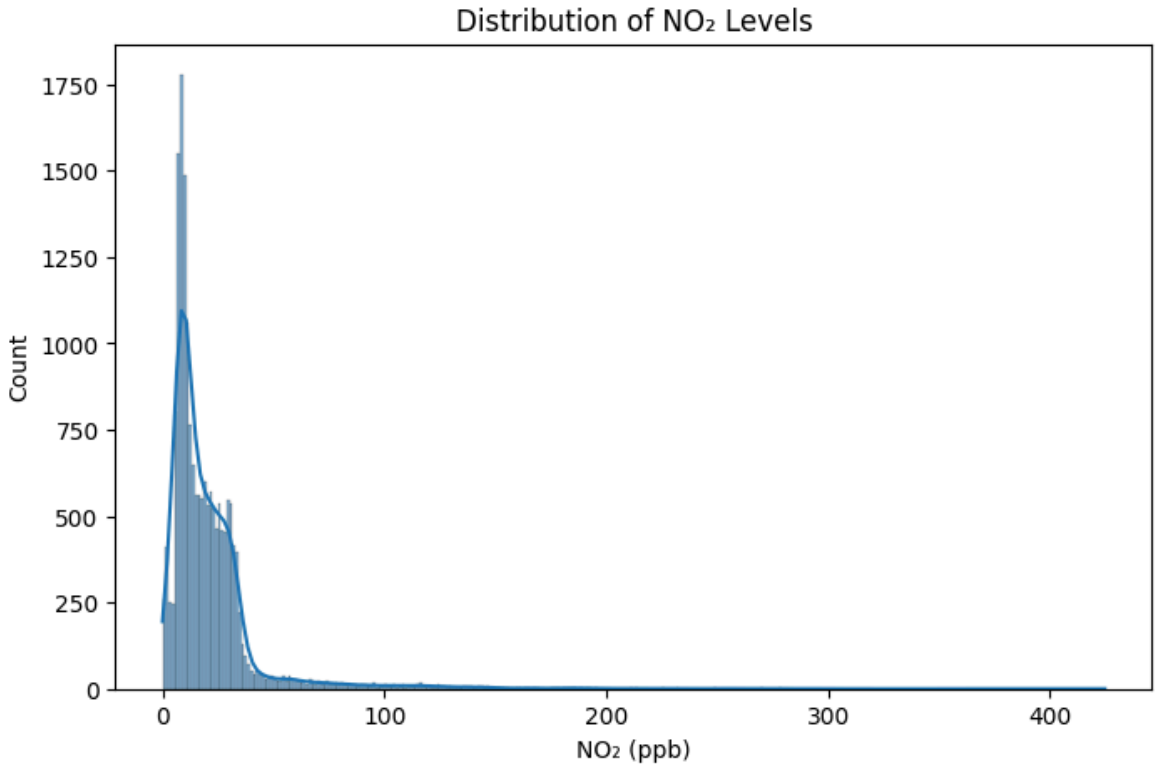
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 18862 entries, 0 to 18861
Data columns (total 12 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   Unique ID       18862 non-null  int64  
 1   Indicator ID    18862 non-null  int64  
 2   Name            18862 non-null  object 
 3   Measure         18862 non-null  object 
 4   Measure Info    18862 non-null  object 
 5   Geo Type Name   18862 non-null  object 
 6   Geo Join ID     18862 non-null  int64  
 7   Geo Place Name  18862 non-null  object 
 8   Time Period     18862 non-null  object 
 9   Start_Date      18862 non-null  object 
 10  Data Value      18862 non-null  float64
 11  Message         0 non-null      float64
dtypes: float64(2), int64(3), object(7)
memory usage: 1.7+ MB
```

Out[ ]:
```
Index(['Unique ID', 'Indicator ID', 'Name', 'Measure', 'Measure Info',
       'Geo Type Name', 'Geo Join ID', 'Geo Place Name', 'Time Period',
       'Start_Date', 'Data Value', 'Message'],
      dtype='object')
```

In [ ]:
```
# Step 4: Check for missing values and duplicates
print(df.isnull().sum())
print('Duplicates:', df.duplicated().sum())
```

```
Unique ID             0
Indicator ID          0
Name                  0
Measure               0
Measure Info          0
Geo Type Name         0
Geo Join ID           0
Geo Place Name        0
Time Period           0
Start_Date            0
Data Value            0
Message           18862
dtype: int64
Duplicates: 0
```

In [ ]:
```
# Step 5: Visualize a few features
import matplotlib.pyplot as plt
import seaborn as sns
plt.figure(figsize=(8, 5))
sns.histplot(df['Data Value'], kde=True)
plt.title('Distribution of NO₂ Levels')
plt.xlabel('NO₂ (ppb)')
plt.show()
```



In [ ]:
```
# Step 6-8: Identify target, preprocess date, encode categorical
df['Start_Date'] = pd.to_datetime(df['Start_Date'], errors='coerce')
df['Year'] = df['Start_Date'].dt.year
df['Month'] = df['Start_Date'].dt.month
df = pd.get_dummies(df, columns=['Geo Type Name', 'Geo Place Name'], drop_first=
```

In [ ]:
```
# Step 9: Feature Scaling
from sklearn.preprocessing import StandardScaler
X = df[['Geo Join ID', 'Year', 'Month'] + [col for col in df.columns if 'Geo Pla
y = df['Data Value']
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
```

In [ ]:
```
# Step 10: Train-test split
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2,
```

In [ ]:
```
# Step 11: Model building
from sklearn.ensemble import RandomForestRegressor
model = RandomForestRegressor()
model.fit(X_train, y_train)
```

Out[ ]:
```
▾ RandomForestRegressor
RandomForestRegressor()
```

In [ ]:
```
# Step 12: Evaluation
from sklearn.metrics import mean_absolute_error, r2_score
y_pred = model.predict(X_test)
print('MAE:', mean_absolute_error(y_test, y_pred))
print('R² Score:', r2_score(y_test, y_pred))
```

```
MAE: 15.607572509674329
R² Score: 0.07800469089825934
```

In [ ]:
```
# Step 13: Make predictions from new input
sample = X_test[0].reshape(1, -1)
print('Prediction:', model.predict(sample))
```

```
Prediction: [15.68872972]
```

In [ ]:
```
# Step 16-18: Deployment with Gradio
!pip install gradio
import gradio as gr
def predict_no2(geo_id, year, month):
    import numpy as np
    input_data = pd.DataFrame([[geo_id, year, month]], columns=['Geo Join ID', '
    for col in X.columns:
        if col not in input_data.columns:
            input_data[col] = 0
    input_scaled = scaler.transform(input_data[X.columns])
    prediction = model.predict(input_scaled)
    return f'Predicted NO₂ Level: {prediction[0]:.2f} ppb'
interface = gr.Interface(fn=predict_no2, inputs=['number', 'number', 'number'],
interface.launch()
```

```
Collecting gradio
  Downloading gradio-5.29.0-py3-none-any.whl.metadata (16 kB)
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ython-multipart, groovy, ffmpy, aiofiles, starlette, safehttpx, gradio-client, fa
stapi, gradio
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gradio-client-1.10.0 groovy-0.1.2 pydub-0.25.1 python-multipart-0.0.20 ruff-0.11.
8 safehttpx-0.1.6 semantic-version-2.10.0 starlette-0.46.2 tomlkit-0.13.2 uvicorn
-0.34.2
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Colab notebook detected. To show errors in colab notebook, set debug=True in laun
ch()
* Running on public URL: https://52e21734bbf13d2534.gradio.live

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un `gradio deploy` from the terminal in the working directory to deploy to Huggin
g Face Spaces (https://huggingface.co/spaces)
```

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Out[ ]: