# AQI Prediction Using Machine Learning in Indian Cities

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# Introduction

# Overview of the Project

The project focuses on predicting the Air Quality Index (AQI) using machine learning techniques specifically tailored for various cities across India.

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Course :Introduction to Ai

Institution: KIET Group of institution

Date: [Insert Date] 27 may 2025

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# Problem Statement

# Why Predict AQI?

## Air Pollution Concern

Air pollution is a growing concern in many urban areas in India, leading to various health issues.

## Air Quality Index

The Air Quality Index (AQI) serves as a standardized measure to assess how polluted the air is in specific locales.

## AQI Prediction

Timely prediction of AQI can greatly assist in public health planning and enable individuals to make informed decisions regarding outdoor activities.

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# Dataset Overview

# Dataset Description

1 Data Source

Source: Kaggle – Air Quality Data in India

2 Time Frame

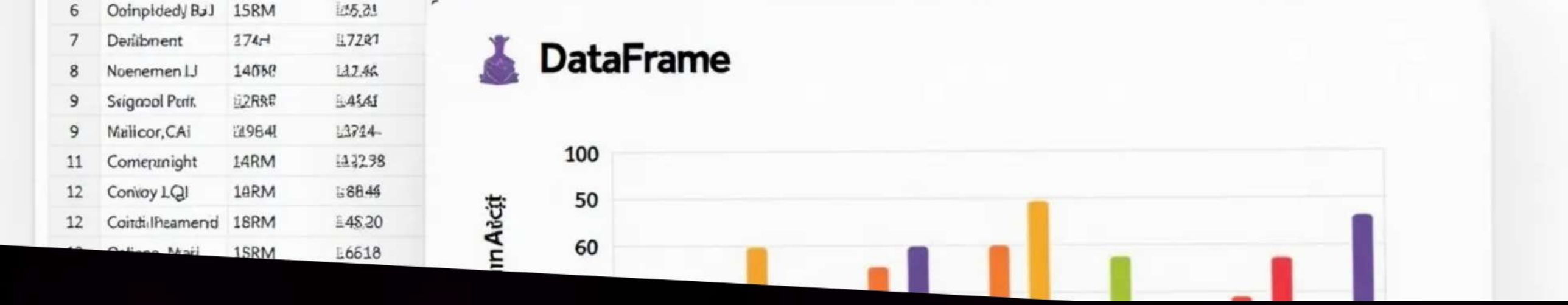
Time Period: 2015–2020

3 Cities Included

Cities: Multiple major Indian cities across the country

4 Key Features

Key Features Included:
- PM2.5, PM10, NO2, SO2, CO, O3
- Date, City, AQI




# Dataset Description

## Data Visualization

Visualization of the dataset can include:

.regression graph representing Actual vs predicted Aqi

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# Data Preprocessing

# Data Cleaning & Preparation

## Data Integrity

Removed any missing and duplicate entries to ensure data integrity.

## Date Conversion

Converted string date formats into datetime objects for easier analysis.

## NaN Values Handling

Handled NaN values appropriately using methods such as interpolation or mean imputation.

## Dataset Normalization

Normalized the datasets using techniques like MinMaxScaler or StandardScaler to prepare data for modeling.

Code Snapshot

# Data Cleaning & Preparation

## Code Snapshot

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# Understanding Code

# Understanding the Data

## AQI Trends Analysis

Analyzed the trends of AQI over different time periods to gauge fluctuations.

## Correlation Heatmap

Generated a correlation heatmap to understand relationship strengths among various pollutants.

## Polluted Cities

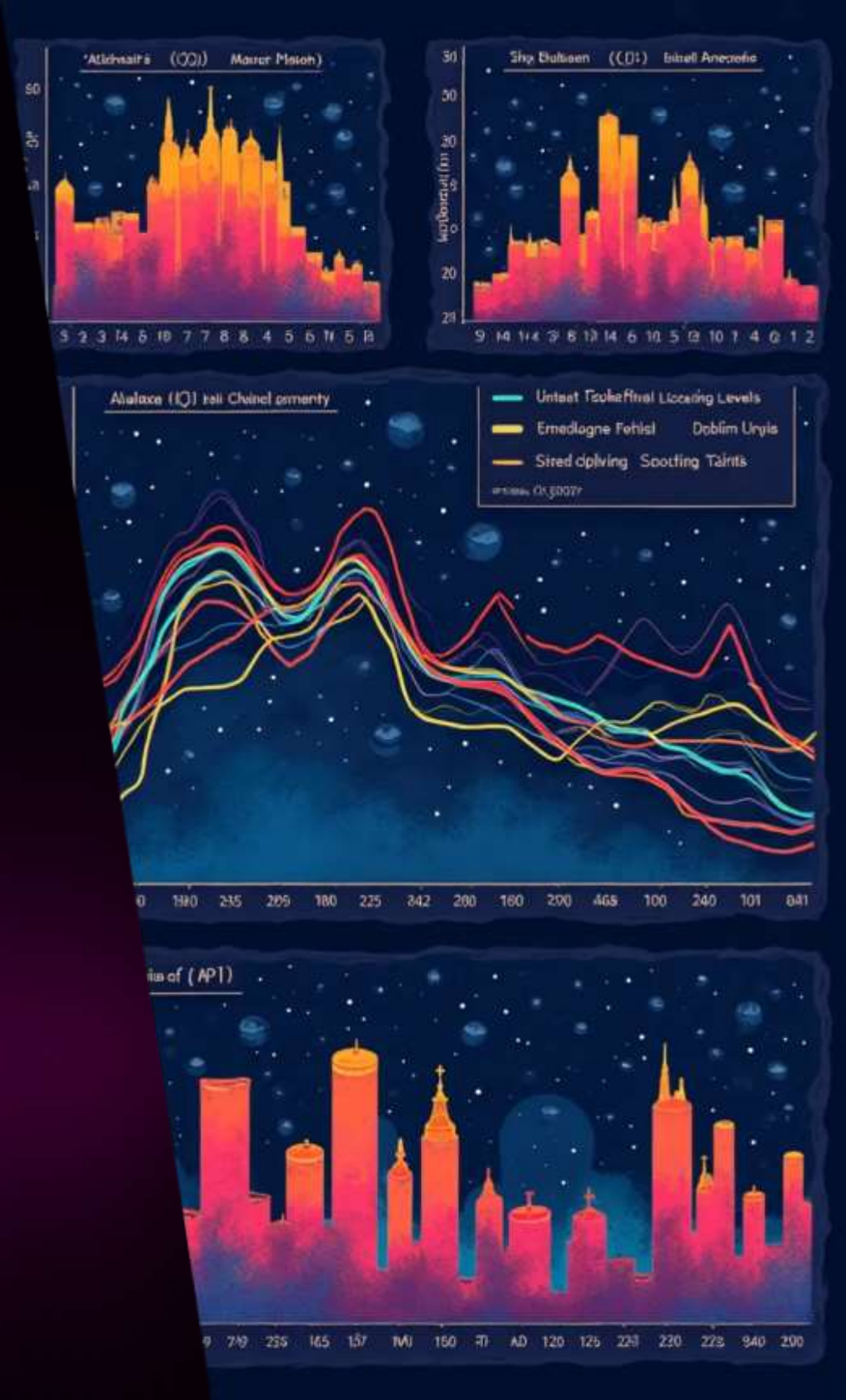
Identified the most polluted cities based on available data.

# Understanding the Data

## Visualizations

Created visualizations such as:

- Line plots depicting AQI trends over time.
- Heatmaps illustrating correlation between pollutants.
- Bar charts representing average AQI levels categorized by city.



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# Model Selection - Random forest Regression

# Why ?

## Ensemble of Decision Trees

A Random Forest is made up of many Decision Trees. Each tree is trained on a random subset of the data. This is called bagging (Bootstrap Aggregating). The idea is to reduce overfitting and increase accuracy

## Feature Randomness

When a tree is split at each node, a random subset of features is chosen rather than using all features. This helps ensure the trees are less correlated with each other, which improves the model's generalization

## Voting or Averaging

For classification, each tree votes for a class, and the majority vote is the final prediction.

For regression, the final output is the average of all tree predictions.

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# Model Evaluation

# Model Performance.

Metrics:

Mean Squared Error (MSE): e.g., 110.45

$R^2$ Score: e.g., 0.89 (means 89% of variance in AQI is explained by the model)

✅ High $R^2$ indicates good model fit.

CODE:-

```
from google.colab import files
import zipfile
import io
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, r2_score
# Step 1: Upload the ZIP file
print("Upload the ZIP file containing the AQI dataset...")
uploaded = files.upload()
# Step 2: Extract ZIP contents
for file_name in uploaded.keys():
```


# Model Performance

## Visualization

A predicted vs actual AQI scatter plot was created to visualize the model's performance.

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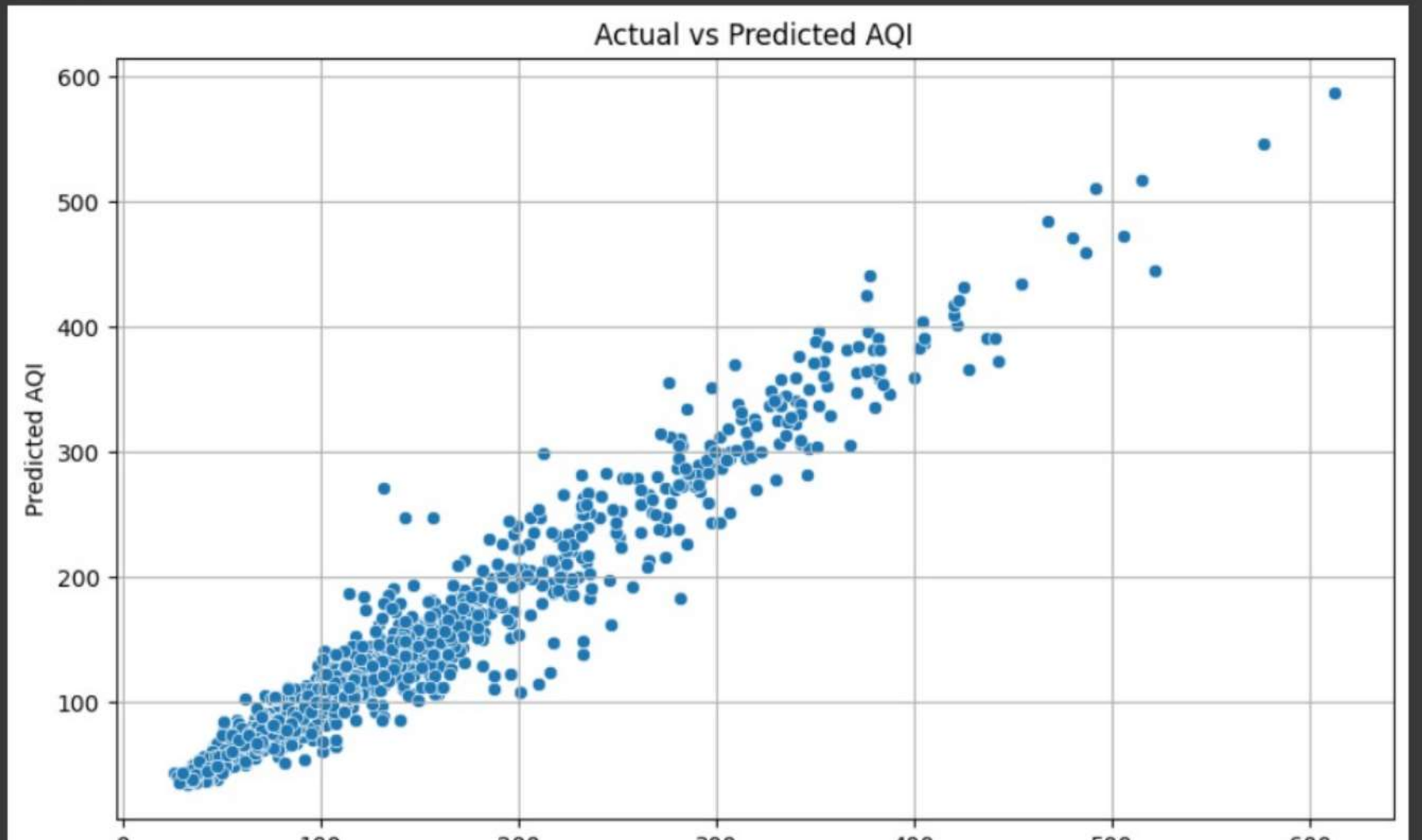
# Visualization of Results

Choose Files archive (2).zip

- **archive (2).zip**(application/x-zip-compressed) - 76469579 bytes, last modified: 5/27/2025 - 100% done

```
Saving archive (2).zip to archive (2) (1).zip
MSE: 429.13
R²: 0.95
```



# Regional AQI Visualization

Mapped AQI values across cities to identify regional pollution hotspots.

This helps in visualizing the distribution of air quality on a geographical scale.

# Regional AQI Visualization

## Tools Used

•Utilized visualization libraries such as matplotlib, seaborn, or plotly.

## Visualization Comparison

•Created a choropleth or bubble map of India highlighting the AQI levels across various locations.

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# Challenges & Improvements

# Limitations & Future Work

Addressed issues regarding data quality and missing value entries which can skew results.

Noted city-wise imbalanced data that could affect model accuracy.

Suggested incorporating additional weather data to enhance model performance.

Future enhancements could include the use of deep learning techniques such as Long Short-Term Memory (LSTM) networks for time series forecasting.

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## Conclusion & Q/A

# Conclusion

The Support Vector Regression (SVR) model effectively predicted AQI levels with substantial accuracy.

Notably, pollution levels exhibit considerable variation across different regions, which is critical for policy-making.

The predictive models developed can serve as valuable tools in guiding pollution control strategies and public health initiatives.

Closing Line: "Questions? Happy to discuss!"

# Thank You