

Exploratory Data Analysis Report

Time-Series Plots

- Variations in pollutant concentrations over time are seen.
- Missing values result in gaps in data, which need to be addressed in preprocessing.

Hourly Patterns

- NO_x(GT) exhibits a clear diurnal pattern, peaks during morning and evening hours.
- CO(GT) and C₆H₆(GT) remain constant over the day.

Weekly Patterns

- NO_x(GT) is highest on weekdays and reduces significantly on weekends.
- CO(GT) and C₆H₆(GT) vary very little over the week.

Correlation Analysis

- Strong positive correlations between CO, NO_x, and Benzene (C₆H₆), reflecting common emission sources.

Temporal Patterns and Decomposition Analysis

- Decomposition of Carbon Monoxide (CO) reflects values from near zero to approximately 7.5 mg/m³.
- Trend component reflects elevated CO concentrations in mid-March and mid-April 2004, and low levels in early and late April.
- Seasonal component reflects an obvious daily cyclical pattern with very consistent oscillations.

Health and Environmental Implications

- CO levels occasionally reach over 5 mg/m³, reaching levels of potential health significance.
- Presence of multiple traffic-related pollutants simultaneously may produce multiplicative health effects.

Analysis of Potential Factors

Anthropogenic Factors:

- Transportation: Huge sources of air pollutants, particularly diesel-fueled vehicles.
- Rush Hour Peaks: Significant concentrations of NO_x during morning and evening rush hour during weekdays.
- Industrialization: Toxic pollutant emissions like NO_x and Benzene through the combustion of fossil fuels.
- Domestic Use of Fossil Fuels: Combustion of solid fuels for heating and cooking, which results in particulate matter and CO emissions.

Meteorological Factors:

- Temperature: Lower winter temperatures decrease atmospheric turbulence and chemical reactions, causing higher levels of pollutants.

- Humidity: High humidity prefers wet deposition mechanisms, affecting the concentrations of pollutants.
- Wind Speed: Low wind speeds retard pollutant dispersion, leading to concentration in the urban area.
- Seasonal Variations: Winter leads to high concentrations of CO and NO_x due to extra heating needs.

Urban Form and Population Density

- Urbanization Stage: Greater residential areas can lower mean pollutant levels, but inner urban areas still experience poor air quality.
- Population Density: Higher population densities enhance transportation demands and fuel consumption, raising pollutant concentrations.

Chemical Interactions:

- Pollutants like NO_x undergo physicochemical reactions, forming secondary pollutants like ozone and PM_{2.5}.

Seasonal Trends in Pollutants:

- Carbon Monoxide (CO): Rush hour diurnal peaks and seasonal maxima in winter.
- Nitrogen Oxides (NO_x): Elevated levels during weekdays due to traffic emissions.
- Benzene: Good correlation with CO, indicating shared sources from car exhausts.