Analysis of Air Quality Across London City in Year 2022

S18-834

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1 Introduction

The quality of air in urban environments is of topmost importance due to its significant impact on public health and the environment. In recent years, cities like London have been increasingly concerned with monitoring and analyzing air quality data to understand trends, identify sources of pollution, and implement effective measures for improvement.

This report presents an exploratory data analysis of air quality data collected across London City from January 1, 2022, to December 31, 2023. The dataset consists of hourly measurements of various air pollutants, including NO_2, NO_x, NO, O_3, SO_2, PM_{10} and $PM_{2.5}$, obtained from 36 air monitoring sites strategically located throughout the city. Furthermore, information about each monitoring site, such as identification code, name, latitude,longitude, and the substance measured, is provided in the additional dataset "london_local_sites".

The primary objective of this analysis is to discover trends and patterns in air quality across different locations in London over the specified period. By examining variations in pollutant levels, spatial distribution, and temporal trends, this study aims to contribute valuable insights into the state of air quality within the city.

Through this exploratory analysis, I aim to contribute to the understanding of air quality dynamics in London and support informed decision-making towards the enhancement of urban air quality and public health.

2 Literature Review

Air pollution is a severe environmental and public health issue which has taken significant attention worldwide. Efforts to monitor and reduce air pollution are essential for safeguarding public health and the environment. This literature review examines key statistical methods that have been used to analyse and

discover the trends in air quality across London city from three prominent reports focusing on air quality in the UK, published between 2022 and September 2023.

01) Air Pollution in the UK 2022-September 2023 by the Department for Environment, Food and Rural Affairs (DEFRA):

The report by DEFRA provides a comprehensive overview of air pollution trends and patterns in the UK spanning the year 2022. Through extensive data analysis and interpretation, DEFRA highlights key indicators of air quality, including levels of pollutants such as nitrogen dioxide (NO2), particulate matter (PM10 and PM2.5), Ozone (O3), and Sulfur dioxide (SO2). The report examines spatial and temporal variations in air pollution levels, identifying hotspots and areas of concern across different regions of the UK.

DEFRA's analysis incorporates statistical methods to assess the impact of various factors on air quality, including emissions from transportation, industrial activities, and residential sources. By utilizing advanced statistical techniques, such as regression analysis and time series modelling, DEFRA offers insights into the drivers of air pollution and potential mitigation strategies.

Furthermore, the report evaluates compliance with air quality standards and regulations set by the UK government and the European Union. Statistical metrics, such as compliance rates and exceedance frequencies, are utilized to assess the effectiveness of existing air quality policies and identify areas requiring additional measures for pollution control and management.

02) Westminster City Council Air Quality Annual Status Report for 2022:

The annual status report published by the Westminster City Council offers valuable insights into air quality conditions within the borough of Westminster for the year 2022. Through statistical analysis of air quality monitoring data, the report assesses pollutant levels, trends, and spatial distribution across different neighbourhoods and monitoring sites within Westminster.

Utilizing statistical techniques such as descriptive statistics and trend analysis the report identifies areas of concern and sources of air pollution within the borough. Statistical indicators, including annual average concentrations, standard deviations, and percentile values, are used to characterize air quality and assess compliance with regulatory standards.

Moreover, the report examines the impact of key factors such as traffic emissions, industrial activities, and urban morphology on air quality patterns in Westminster. Statistical regression analysis may be employed to quantify the relationship between pollutant concentrations and various influencing factors, providing valuable insights for air quality management and policy formulation.

03) City of London Corporation Air Quality Annual Status Report for 2022:

Authored by Paul Bentley, Air Quality Officer, and Ruth Calderwood, Air Quality Manager, the City of London Corporation's annual status report offers a detailed analysis of air quality conditions within the City of London for the year 2022. The report employs statistical methods to analyze air pollutant concentrations, trends, and spatial distribution across monitoring sites within the city.

Statistical techniques such as descriptive analysis and time series analysis are utilized to identify temporal variations, spatial patterns, and potential sources of air pollution in the City of London. Through statistical modelling, the report may assess the effectiveness of air quality interventions and predict future air quality trends based on various scenarios and policy measures.

This statistical literature review provides an overview of recent reports on air quality in the UK, focusing on statistical methods and findings presented in documents published by DEFRA, the Westminster City Council, and the City of London Corporation. These reports contribute to our understanding of air pollution trends, patterns, and management strategies, providing valuable insights for policymakers, researchers, and stakeholders involved in air quality management and public health.

3 Results and Discussion

3.1 Summary of Parameter measured in each Site

3.2 NO_x in each Month

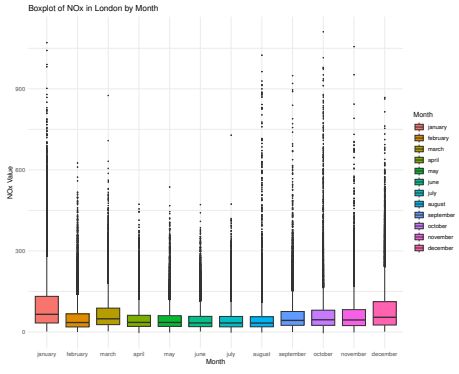

Figure 1: NO_x in each Month

site	Parameter name	Mean	Median	Min	Max	SD
Brent - John Keble Primary School	Nitrogen dioxide	45.21081	30.90000	2.80000	741.7000	53.49371
Brent - John Keble Primary School	PM10 particulate matter (Hourly measured)	45.21081	30.90000	2.80000	741.7000	53.49371
Brent - ARK Franklin Primary Academy	Nitrogen dioxide	50.26485	33.90000	1.90000	819.3000	55.25013
Brent - ARK Franklin Primary Academy	PM10 particulate matter (Hourly measured)	50.26485	33.90000	1.90000	819.3000	55.25013
City of London - Sir John Cass School	Nitrogen dioxide	30.59438	21.50000	1.60000	460.2000	33.13244
City of London - Sir John Cass School	PM10 particulate matter (Hourly measured)	30.59438	21.50000	1.60000	460.2000	33.13244
City of London - Beech Street	Nitrogen dioxide	65.91291	49.30000	3.20000	708.3000	58.00185
City of London - Beech Street	PM10 particulate matter (Hourly measured)	65.91291	49.30000	3.20000	708.3000	58.00185
City of London - Walbrook Wharf	Nitrogen dioxide	114.21560	93.60000	3.70000	729.6000	87.16372
City of	PM10	NaN	NA	Inf	-Inf	NA

3.3 NO_2 in each Month

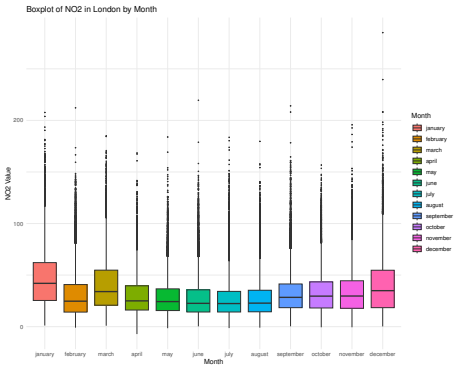

Figure 2: NO_2 in each Month

3.4 NO in each Month

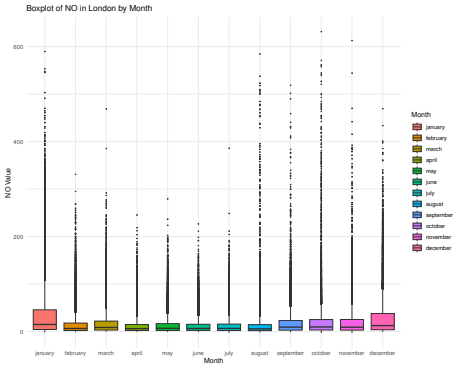

Figure 3: NO in each Month

3.5 PM_{10} in each Month

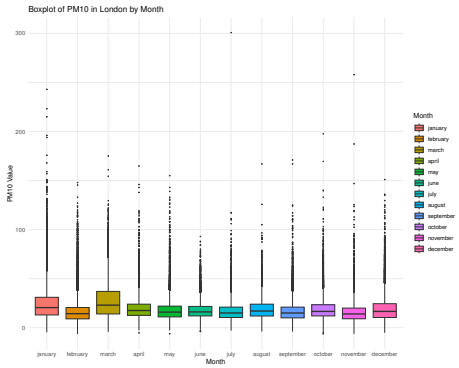

Figure 4: PM_{10} in each Month

3.6 $PM_{2.5}$ in each Month

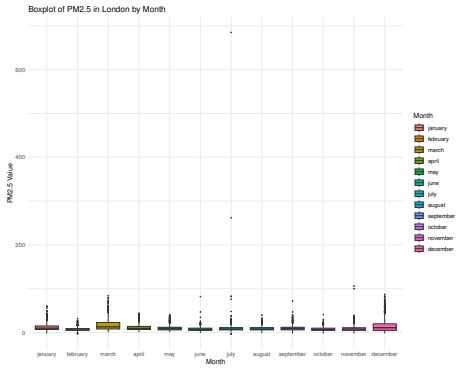

Figure 5: $PM_{2.5}$ in each Month

3.7 Total Amount of Air Pollutants in Each Month in Year 2022

month	Total amount of air pollutants
01	4596983
02	2338595
03	3261107
04	2310568
05	2226913
06	2011924
07	2061997
08	2176580
09	2591667
10	2831317
11	2579491
12	3360687

Table 2: **Total Amount of Air Pollutants in Each Month in Year 2022**

3.8 Mostly found Pollutant

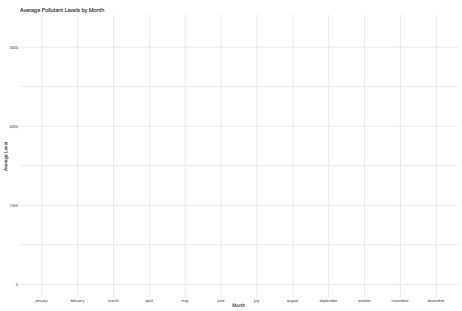

Figure 6: Average amount of pollutants found in each month