**Capstone Project**

**TOPIC:**

## Automating PM10 source apportionment data analysis using Python.

**Abstract**:.

**Keywords:**

Air pollution, Source apportionment, Particulate matter (PM10), Positive Matrix Factorisation, Air Quality, Emissions from industry, Effects on health.

**Section 1: Introduction:**

Global air pollution threatens public health and the environment, requiring immediate action. Research from other countries has illuminated air pollution's complex causes and widespread effects, underlining the need for comprehensive solutions.   
  
Industrial emissions worsen air pollution, as shown by studies linking US steel factory closures to public health improvements (Pope, 1996). Canadian research has shown that industrial air pollution harms human inflammatory and vascular systems (Kumarathasan et al., 2018). Industrialized regions like IJmond in the Netherlands face air pollution despite regulations (de Jonge, 2018, 2019, 2020). Advanced monitoring systems like the Xact 625i Ambient Metals Monitor in Zürich, Switzerland, help understand air pollution dynamics by revealing PM sources (Furger et al., 2020).  
  
  
Even in New Zealand with favourable weather conditions, anthropogenic air pollution exceeds national and international norms and endangers public health. PM2.5 is a major pollutant that can enter the circulatory system and cause health issues (Chen and Hoek, 2020; Nel, 2005).   
  
New Zealand councils like the Auckland Council (AC) are managing air quality to address these issues. PM10, PM2.5, black carbon, CO, NO2, and SO2 are monitored to identify source contributions using Positive Matrix Factorization (PMF) analysis.   
  
The largest source apportionment study in New Zealand is this one. The research uses receptor modelling to determine source contribution patterns from airborne particle samples and gases collected over a decade from four Auckland Region ambient air quality monitoring locations. This project intends to improve Auckland air quality by giving critical insights into air quality dynamics to support management strategies and policy and regulatory assessments.

The remainder of this paper is organized into sections as follows: In section II we will describe the literature review regarding this project which covers various studies conducted globally on-air pollution, especially Particulate Matter on source apportionment techniques, health impacts, regulatory standards, air quality management practises. In section III we will discuss about the methodology, sampling and instrumentation, analysis methods e.g. PMF and Receptor modelling whichever technique is more useful, results obtained from source apportionment. In section IV we will conclude the project.

**Section 2: Literature Review**

The world continues to face a significant problem in the form of air pollution, which is caused by a variety of factors that contribute to negative health consequences and environmental damage. The findings of research conducted in a number of different nations highlight the immediacy of tackling this problem by implementing complete remedies.   
  
An investigation into source apportionment methodologies has been carried out in France. These studies have utilized Multiple Linear Regression (MLR) to establish a connection between oxidative potential (OP) measurements and PM sources that have been identified by Positive Matrix Factorization (PMF) (Refs. France research). An improved comprehension of the inherent OP of each source is achieved with the integration of PMF-derived source contributions through MLR analysis. Weighted least-square regression, also known as WLS, is applied to consider uncertainties in OP measurements, which ultimately results in an improvement in the accuracy of analysis.   
  
In a similar manner, the research conducted in Switzerland has made use of the Xact system, which includes the provision of elemental content data for PM2.5 and PM10. The use of elemental data in PMF analysis makes it possible to accurately identify sources of particulate matter (Refs. Switzerland research). When PM2.5 and PM10 datasets are combined, source identification is improved, particularly for sources that produce coarse particles at higher concentrations.   
  
Research conducted in New Zealand makes use of receptor modelling analysis, more especially Positive Matrix Factorization (PMF) with EPA PMF 5.0, in order to accurately identify sources of particulate matter (Ref. New Zealand research data). The identification of wind directions that are associated with high source contribution values can be facilitated by the utilization of statistical approaches, such as conditional bivariate probability function (CBPF) analysis.   
  
Research in Iran is centred on gaining a knowledge of sand and dust storms (SDSs) and the impact that they have on the quality of the air. According to study conducted in Iran, the Comprehensive Air Quality Model with Extensions (CAMx) is utilized to simulate SDSs episodes, measure dust emissions, and determine the extent to which dust contributes to PM10 concentrations. There is additional assistance in detecting and measuring dust sources through the utilization of trajectory-based receptor models and dust modelling tools.   
  
In addition, rising industry and urbanization in India exacerbate existing air quality problems, making it necessary to implement efficient pollution control measures (Refs. India research). Several studies have brought to light the importance of doing exhaustive source identification research, particularly in areas that have a wide variety of emission sources.   
  
The significance of these findings lies in the fact that they highlight the necessity of utilizing sophisticated source apportionment methodologies and automation tools in order to comprehend the intricate nature of air pollution. Researchers can correctly measure the contributions of sources and devise focused strategies for the management of air quality when they integrate data from diverse sources and employ advanced modelling tools.

**Section 3: Methodology**