

Insert title of project here

Web address for GitHub repository

Name

# Contents

<b>1</b>	<b>Rationale and Research Questions</b>	<b>5</b>
<b>2</b>	<b>Dataset Information</b>	<b>6</b>
<b>3</b>	<b>Exploratory Analysis</b>	<b>7</b>
<b>4</b>	<b>Analysis</b>	<b>8</b>
4.1	Part1: Time Series Analysis . . . . .	8
4.1.1	Seven cities monthly PM2.5 (2000~2021) . . . . .	8
4.2	Question 2: . . . . .	9
<b>5</b>	<b>Summary and Conclusions</b>	<b>10</b>
<b>6</b>	<b>References</b>	<b>11</b>

## List of Tables

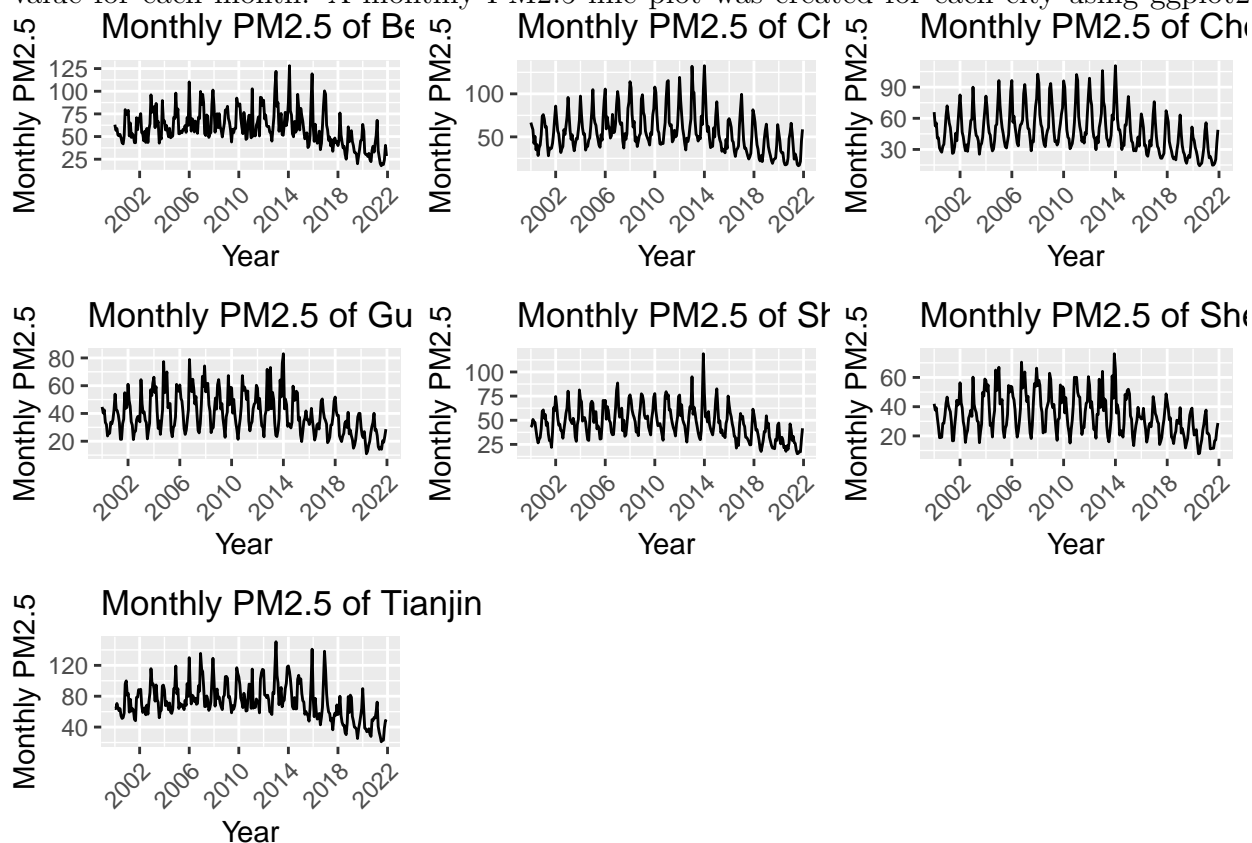
## List of Figures

# 1 Rationale and Research Questions

## 2 Dataset Information

### 3 Exploratory Analysis

To explore the data, we wanted to create a visualization of the monthly PM2.5 for the cities from 2000 to 2021. The data was first filtered to include only the seven cities of interest. Then we grouped the data by city, year, and month and summarized the mean PM2.5 value for each month. A monthly PM2.5 line plot was created for each city using ggplot2.



The plot showed that Beijing and Tianjin had the highest PM2.5 values among the seven cities, and Shenzhen had the lowest values. Most of the cities seemed to have a slow increase in PM2.5 from 2000 to 2006, then stayed relatively constant from 2006 until 2014. In 2014, most cities had a spike in PM2.5. From 2014, PM2.5 in all cities showed a decreasing trend. To better understand the changes in PM2.5, we conducted time-series analysis and predicted the monthly PM2.5 for the seven cities from 2022 to 2026.

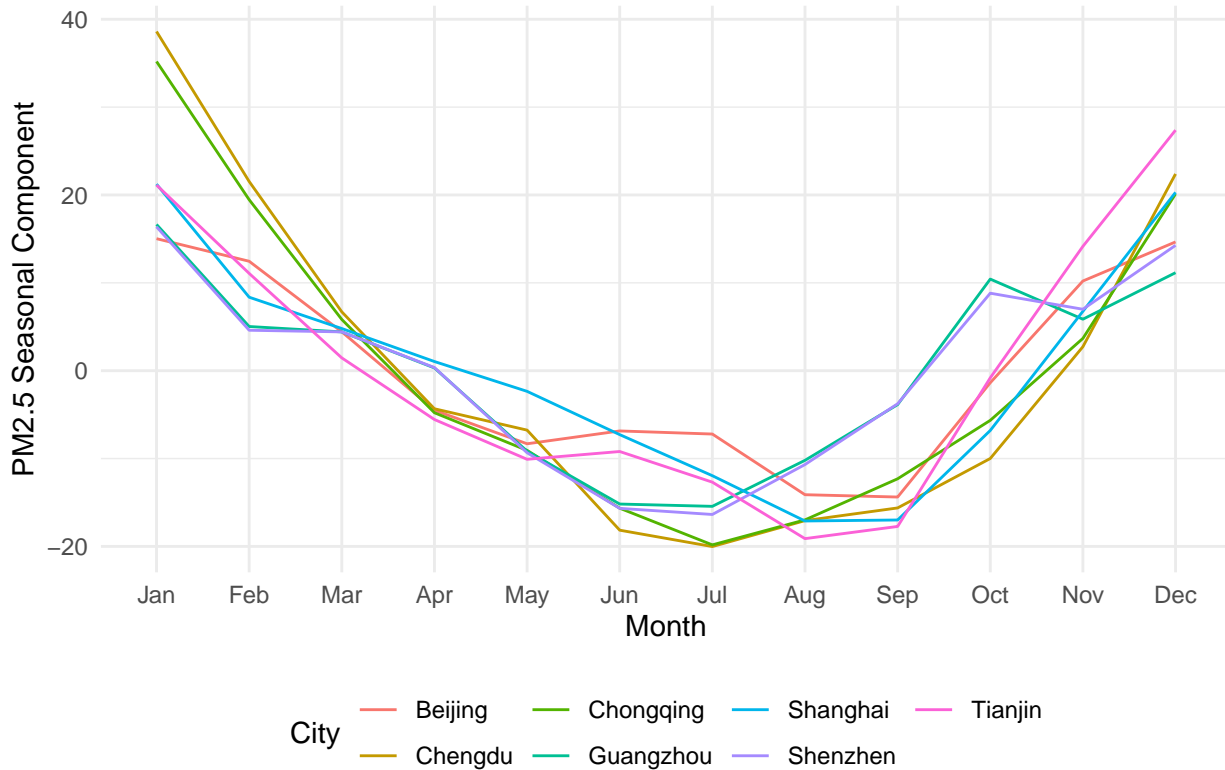
## 4 Analysis

### 4.1 Part1: Time Series Analysis

#### 4.1.1 Seven cities monthly PM2.5 (2000~2021)

Using the STL function, we decomposed the PM2.5 time series data of the target cities into seasonal and trend components and performed a comparative analysis. The PM2.5 values in these cities are generally lower during the summer months (June, July, August, and September) and higher during the winter months (November, December, January, and February) (Figure 2). There are several possible factors contributing to this seasonality: First, In the summer, temperatures are higher, leading to more active air convection, which facilitates the dispersion and dissipation of pollutants in the air. Secondly, there tends to be more rainfall in the summer, which can wash PM2.5 particles from the atmosphere to the ground, reducing their measured values. Thirdly, in the winter, heating demand increases, and in some areas, coal combustion remains the primary method of providing heat. This leads to increased emissions of coal-related pollutants, causing a rise in PM2.5 levels.

Figure 2. Seasonality in PM2.5 in 7 Chinese Cities

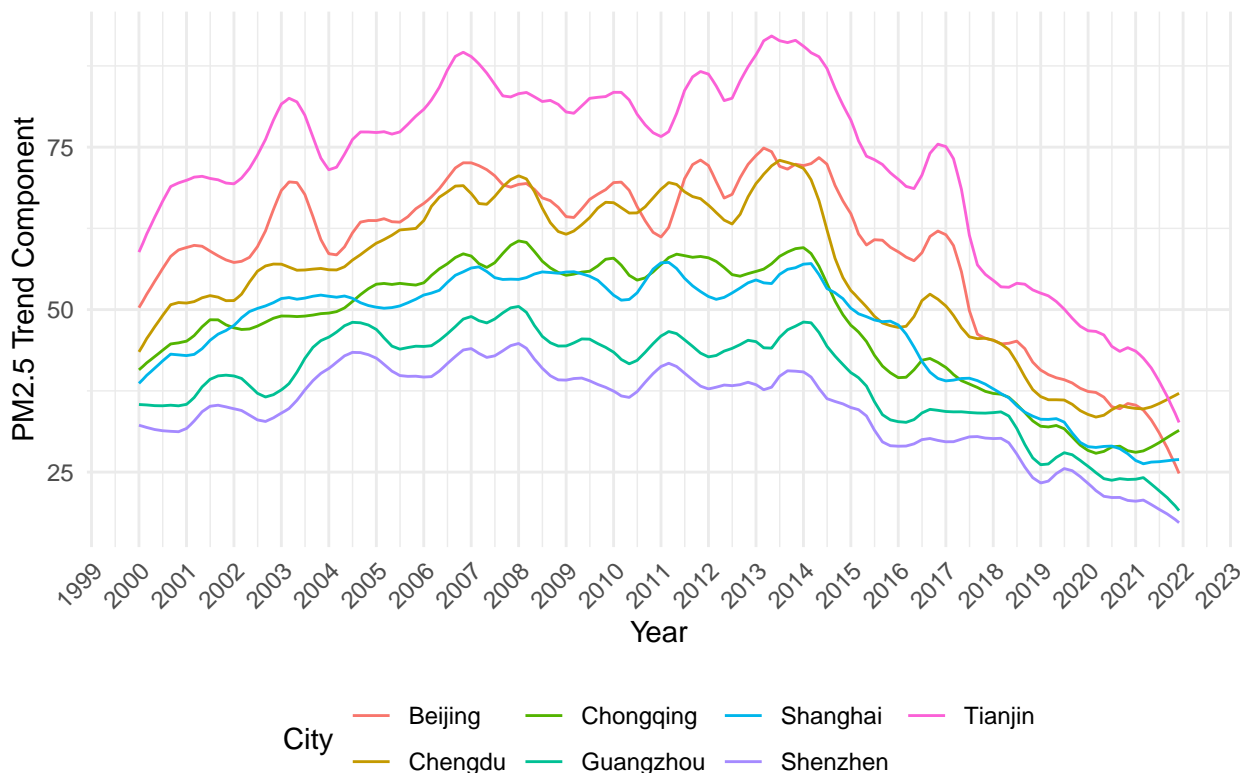


The trend results for the target cities are consistent with those observed in the exploratory analysis (Figure 3). Notably, around 2014 marked a turning point when PM2.5 levels in major cities began to decrease gradually. This shift is likely attributed to the Chinese government's implementation of the Air Pollution Prevention and Control Action Plan, released in September 2013. This plan was the first time the Chinese government set explicit air



quality improvement targets. It required that, by 2017, the annual average PM2.5 concentration in cities at or above the prefectural level should be reduced by more than 10%. In key regions such as Beijing-Tianjin-Hebei, the Yangtze River Delta, and the Pearl River Delta, the plan aimed for reductions of 25%, 20%, and 15%, respectively.

**Figure 3. Trends in PM2.5 in 7 Chinese Cities**



## 4.2 Question 2:

To better visualize the data, we created a dashboard using Shiny. The dashboard consisted of three side panels: “PM2.5 National Distribution”, “Time Series Visualization by City”, “PM2.5 Prediction by City” and three corresponding tab panels: “Map”, “TSA”, and “Prediction”.

The “PM2.5 National Distribution” allows users to drag the map in the “Map” tab and explore the PM2.5 distribution pattern in the country. The “Time Series Visualization by City” panel has a dropdown box that allows users to select the monthly PM2.5 visualization of each city. The results are displayed in the “TSA” tab. Finally, the “PM2.5 Prediction by City” panel has a dropdown box and slider. Users can select the city and the time range to view the monthly PM2.5 prediction in the “Prediction” tab.

## 5 Summary and Conclusions

## 6 References

<add references here if relevant, otherwise delete this section>