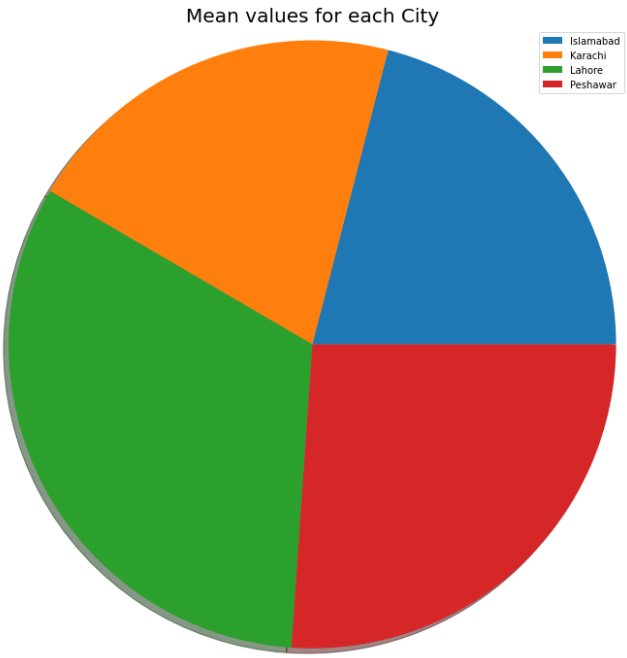
Air Quality Index:

The term air quality index is used by government to indicate how polluted our air is and how many particulates are present in air. As the AQI rises, climate is affected and it also affects people's health.

We are going to analyze data from 29th April 2019 to 20th April 2020 for pm 2.5 and how its trend is and how it varies for major cities of Pakistan. I will not write a formal report but it will be more of a storytelling using graphical representations and figures.

Now before I start, I should explain the term pm 2.5 and why it is so important? PM is a complex and heterogeneous mixture of natural and anthropogenic origin composed of water-soluble inorganic compounds, organic carbons, and elemental carbon and metals. Pm 2.5 is actually concentration of particulate matters that are suspended in our atmosphere and have sizes ranged from diameter of 2.5 micrometer to 10 micrometer. That is about 25 to 100 times thinner than a human air. Frequent examples are dust, pollen etc. Usually this concentration increase as the result from burning forests or chemical industries waste matter or exhaust from cars. Burning fossil fuel also results in increase of pm 2.5.

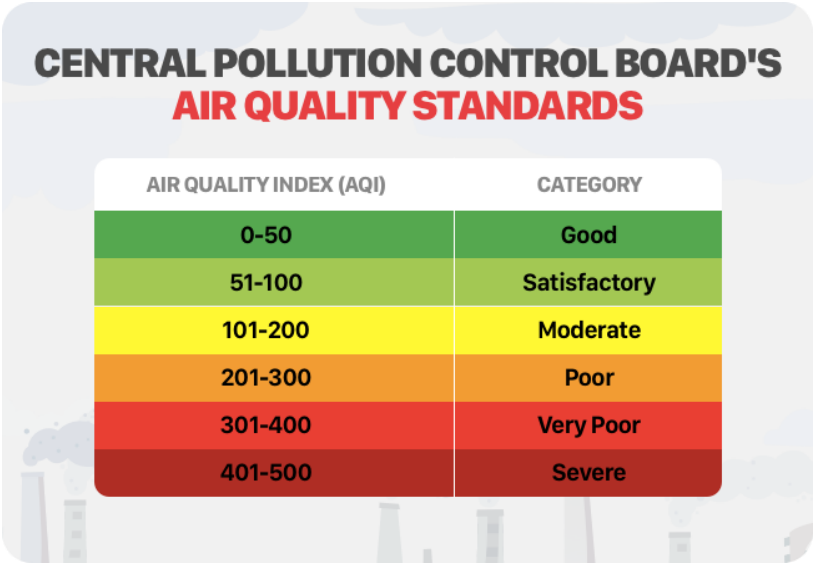
Here, we have data of four major cities of Pakistan; Lahore, Karachi, Peshawar and Islamabad. I would narrate the story though visualization as it is easier to understand.



Here we have pie chart of ratio of mean values for these four major cities, as it is clearly visible, Lahore is the most hazardous city of all others. Lahore has mean value of 178.33 which is the highest of all. Peshawar has the second highest value of 144. One question arises that why Karachi doesn't have

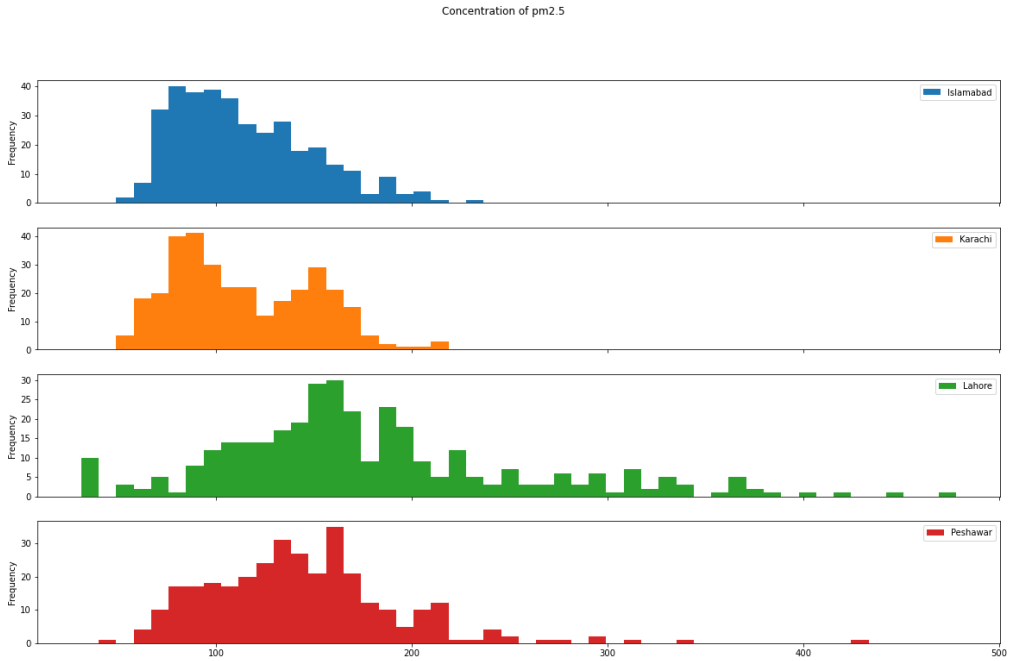
highest pm 2.5 concentration instead of Lahore. After all, Karachi has most densely populated city in Pakistan. We'll get to that in a minute

But why should we worry about pm 2.5, I mean what are the hazards? An increase in concentration of pm 2.5 can cause severe eyes irritation, nose and throat irritation. Prolonged exposure can cause multiple effects such as lung cancer, asthma and Heart Diseases. I have attached a reference below for PM 2.5 allowable concentrations and what concentration is considered Hazardous.



The increase in PM 2.5 concentration also effects our climate. Temperature tends to rise due to the effect of this concentration. Overall average temperature of that region rises. So this PM 2.5 is real trouble.

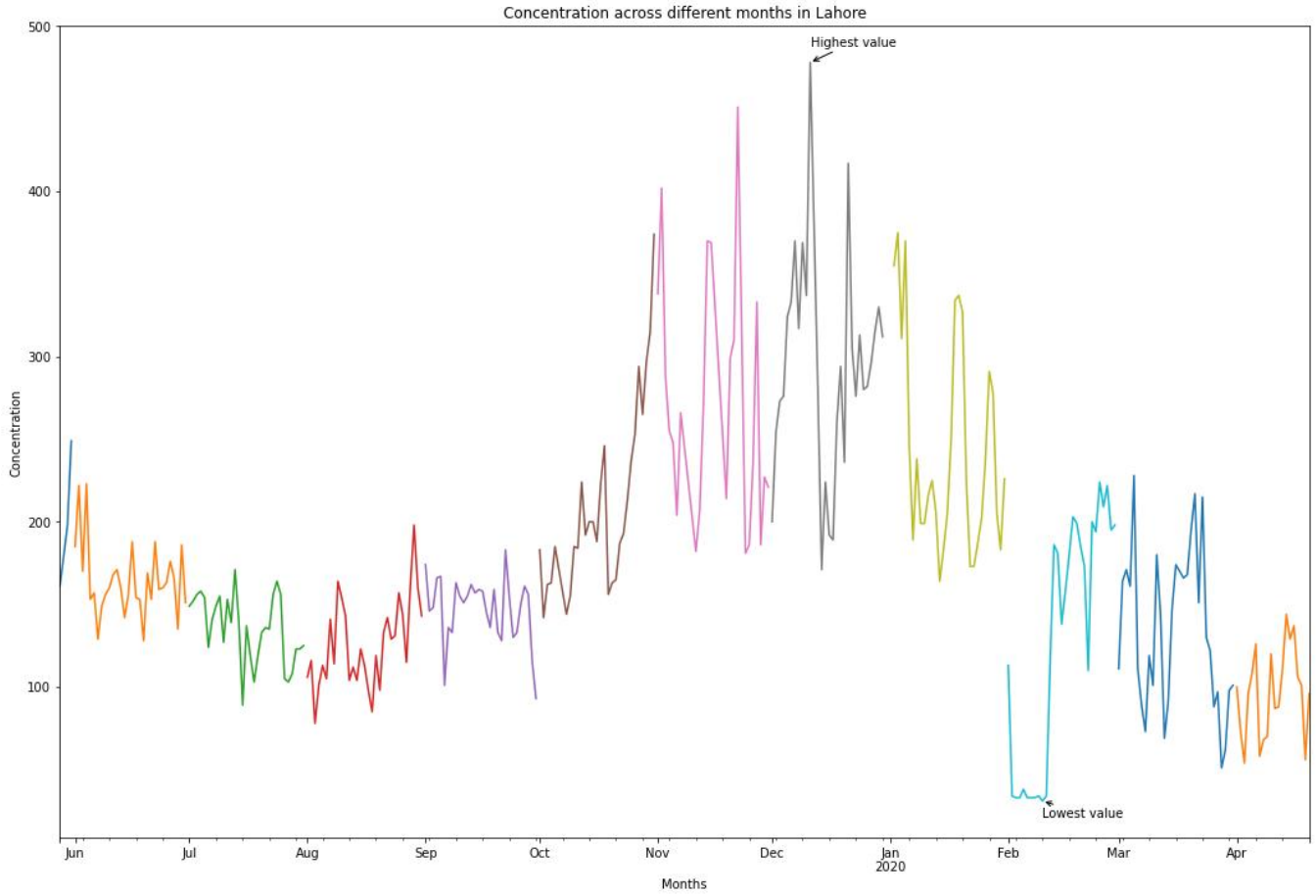
That chart on top explains well the average of values in each city and gives us a well estimate of which city has the highest average value but what about the most common value? And what about which city has the highest minimum and maximum value of PM 2.5.



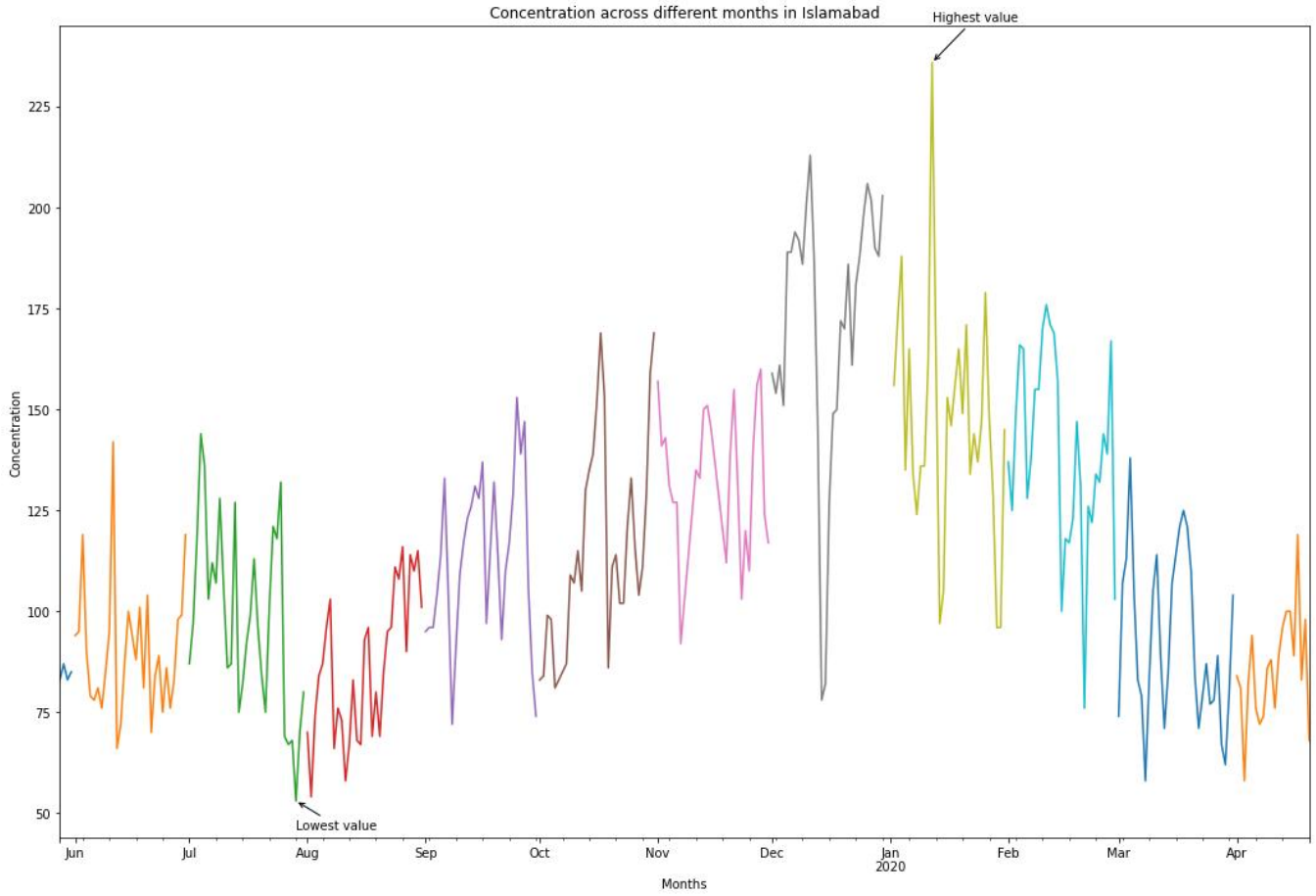
If we look at the chart more closely, we can see that the highest recorded value is in Lahore and smallest recorded value is also in Lahore. The minimum value is in Lahore of 31 and highest value is also in Lahore and is 478! Islamabad has relatively the most consistent data and Karachi shows two different peaks which represent two different common ranges of values.

If we get our sights on the trend of PM 2.5 around whole year, we get a typical trend for every city.

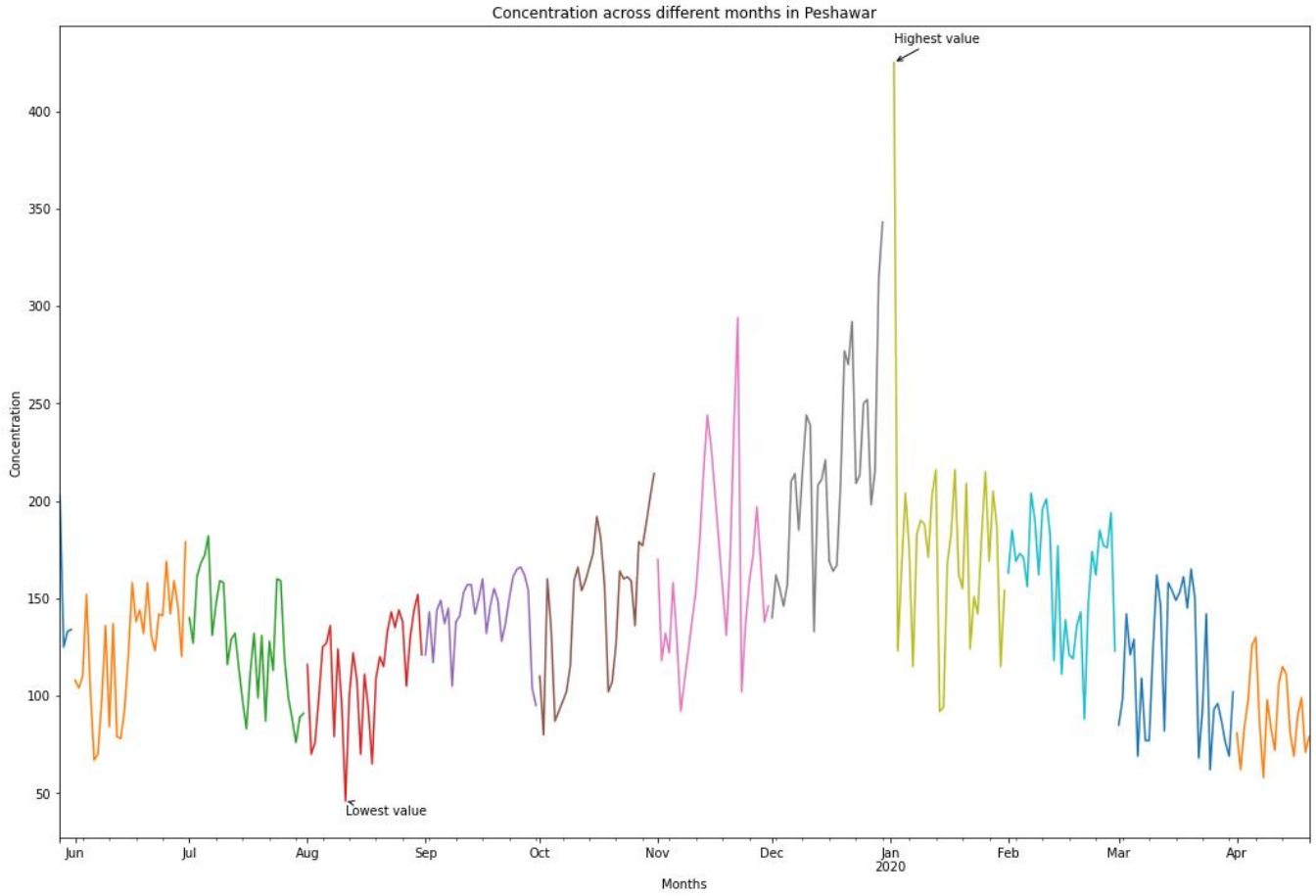
PM 2.5 Trend in Lahore:



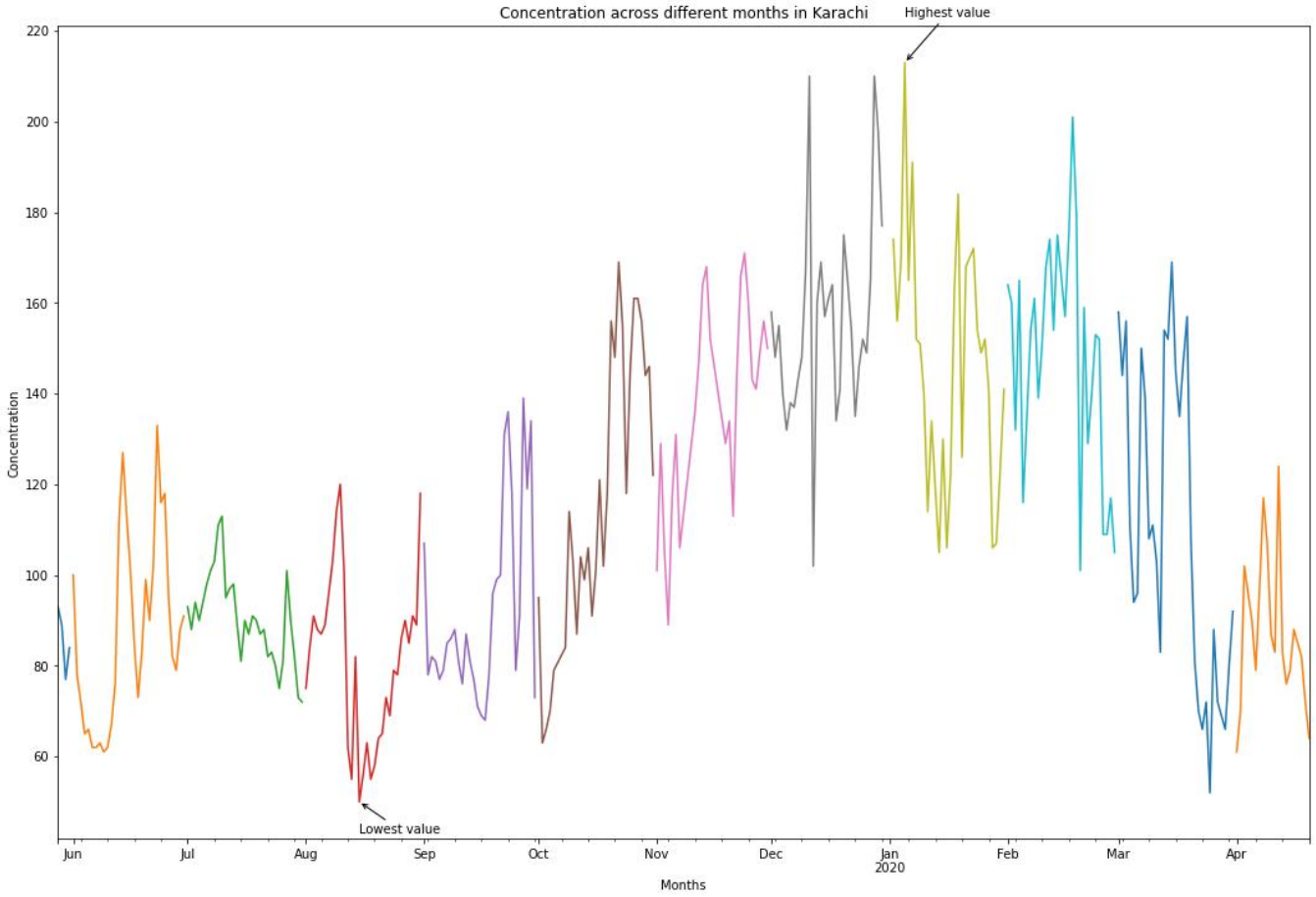
PM 2.5 Trends in Islamabad:



PM 2.5 Trends in Peshawar:

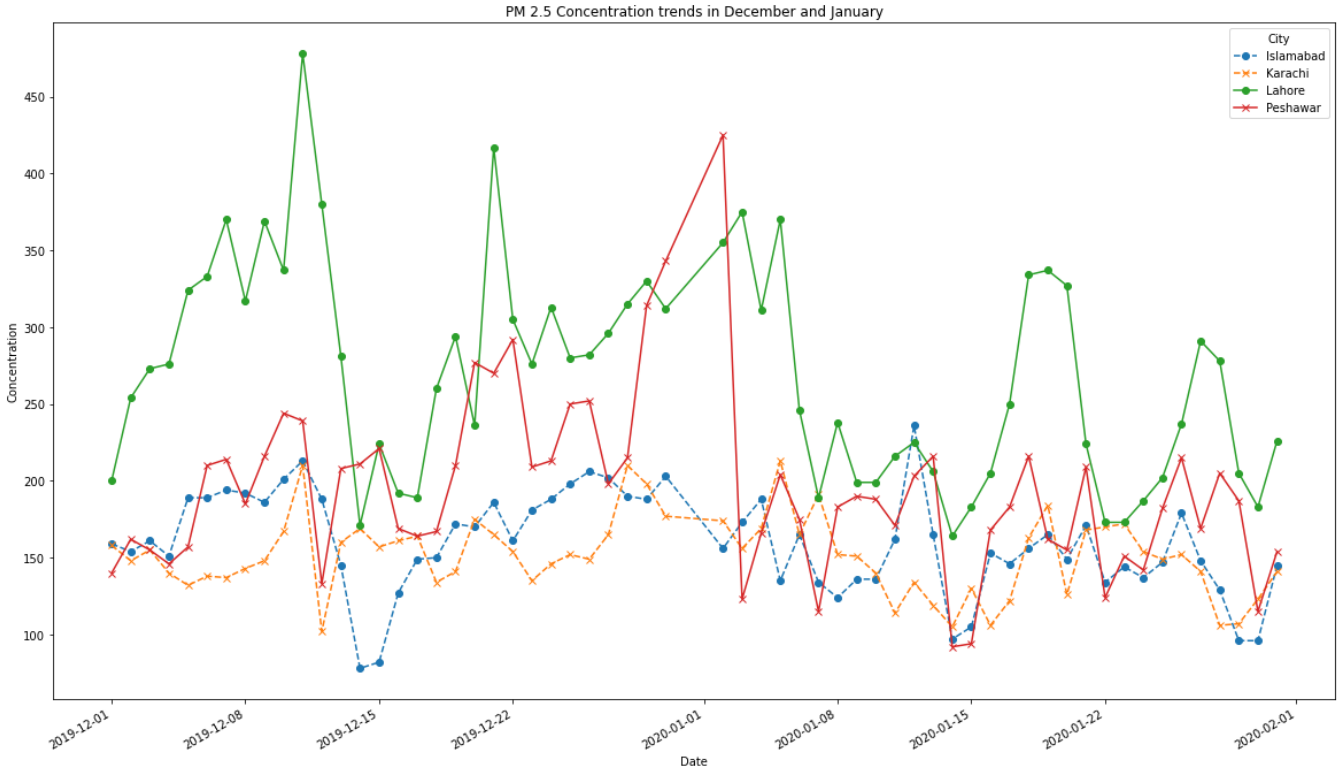


PM 2.5 Trends in Karachi:



These trends show the change and variation in PM 2.5 along the whole time period. If you notice carefully, the highest values in all cities occur in Dec-Jan. This tells us that PM 2.5 values tends to go up in months of December and January. That can be due to many reasons. According to me, this value goes up due to burning of fossil fuels. More fossil fuel is burnt in winters and that may cause increase in concentration of PM 2.5 that much. Also in winters, due to fog, the dust particles tend to settle down and agglomerate. That may also be one of the reason of increased PM 2.5 concentration in winters.

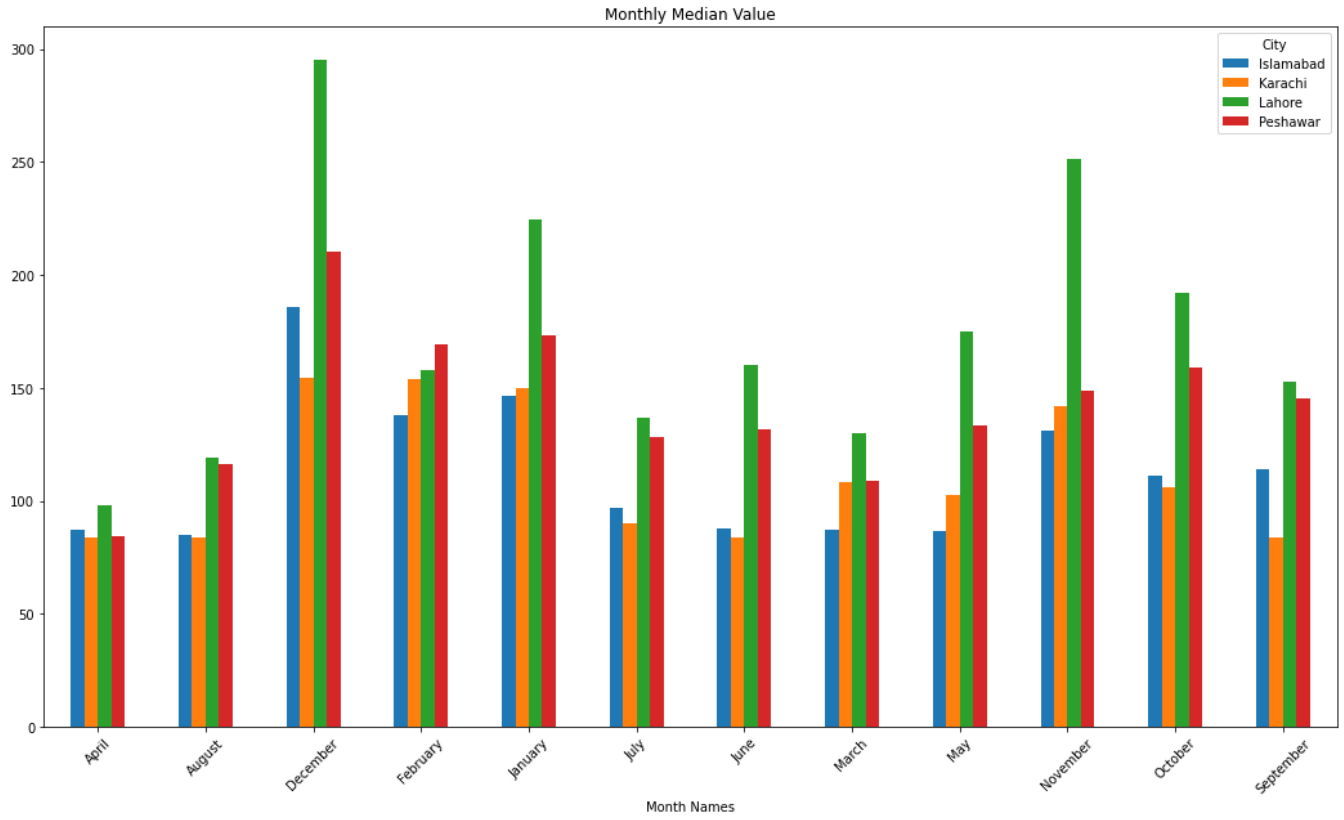
Let's look up the trends of PM 2.5 in December and January. That will show us how they vary during these two months in each city.



As we can see, Lahore tends to have the highest values during these months and Islamabad has the lowest. It we compare their population; Lahore population is almost 10 times higher than Islamabad so it has more concentration of PM 2.5. So we can derive this that the greater the population, the higher is concentration of PM 2.5

Karachi is however an exception because there are strong sea breezes in Karachi and temperature hardly changes there. Average temperature of Karachi is 19.6 Degree Celsius in January according to climate-data.org. For Lahore, this value is 12 Degree Celsius. The effect of strong wind in Karachi is that they carry away the dust particles there so keep the concentration of PM 2.5 low despite of their enormous population.

Lastly I would like to show median average PM 2.5 for each city in different month. This would indicate average PM 2.5 value for each city in different months.



Lahore has the highest value in approximately each month. This is my complete analysis of PM 2.5 in Pakistan.