Analysis of Air Pollution levels in India

By Group 21

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CS685: Data Mining

Outline

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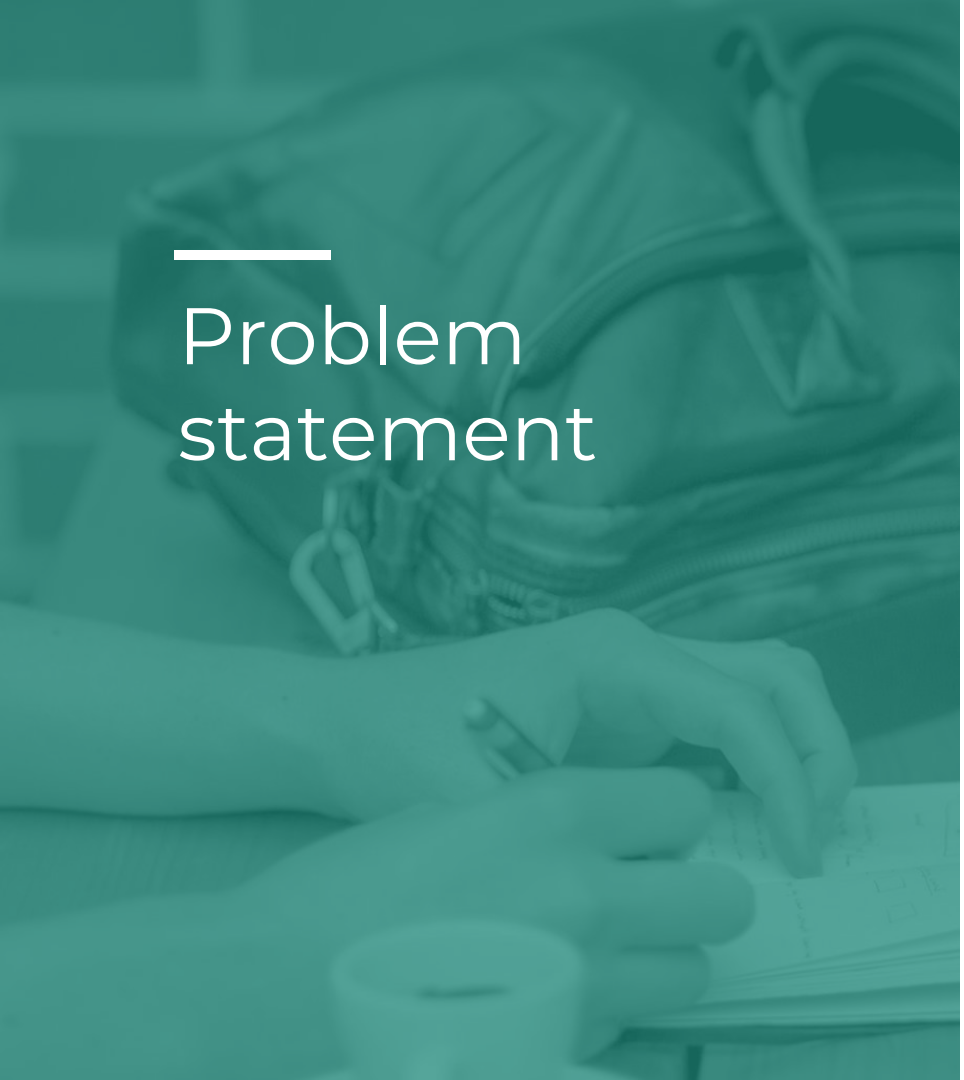

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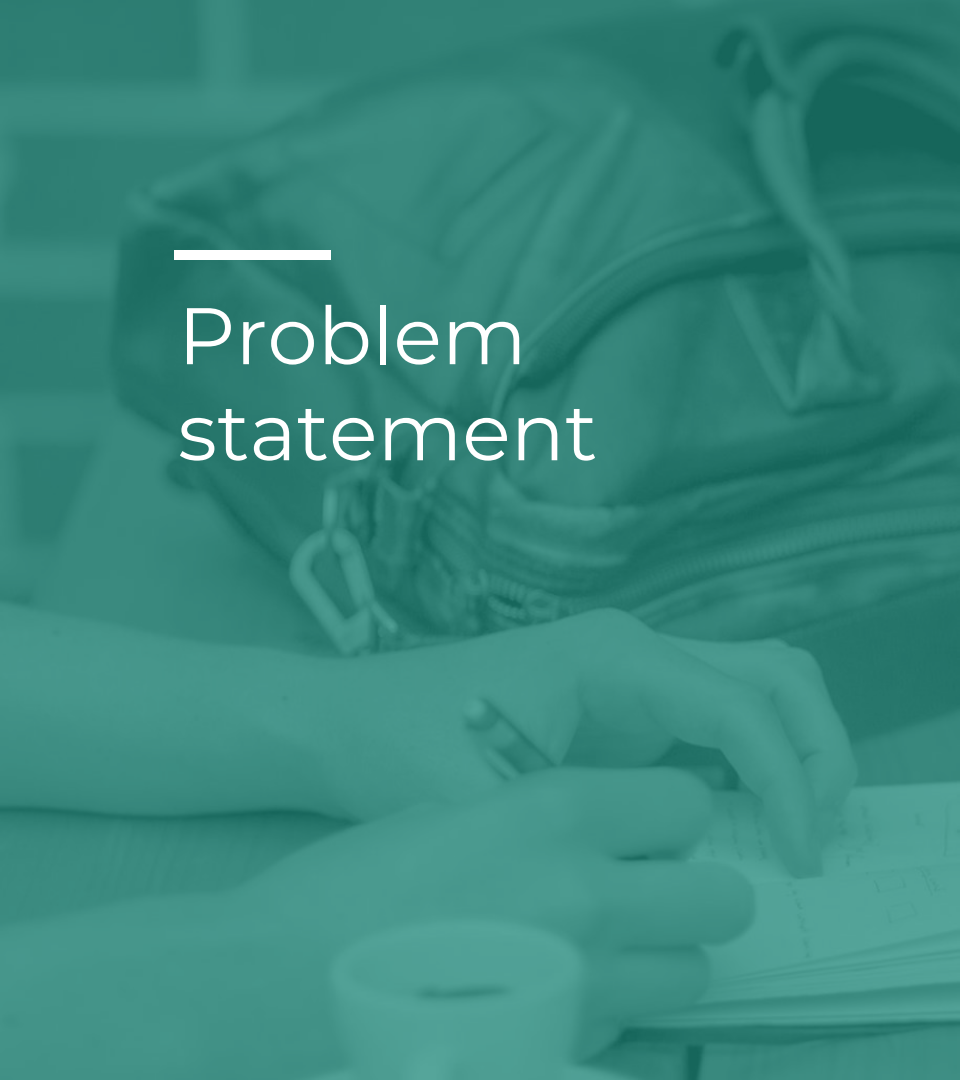

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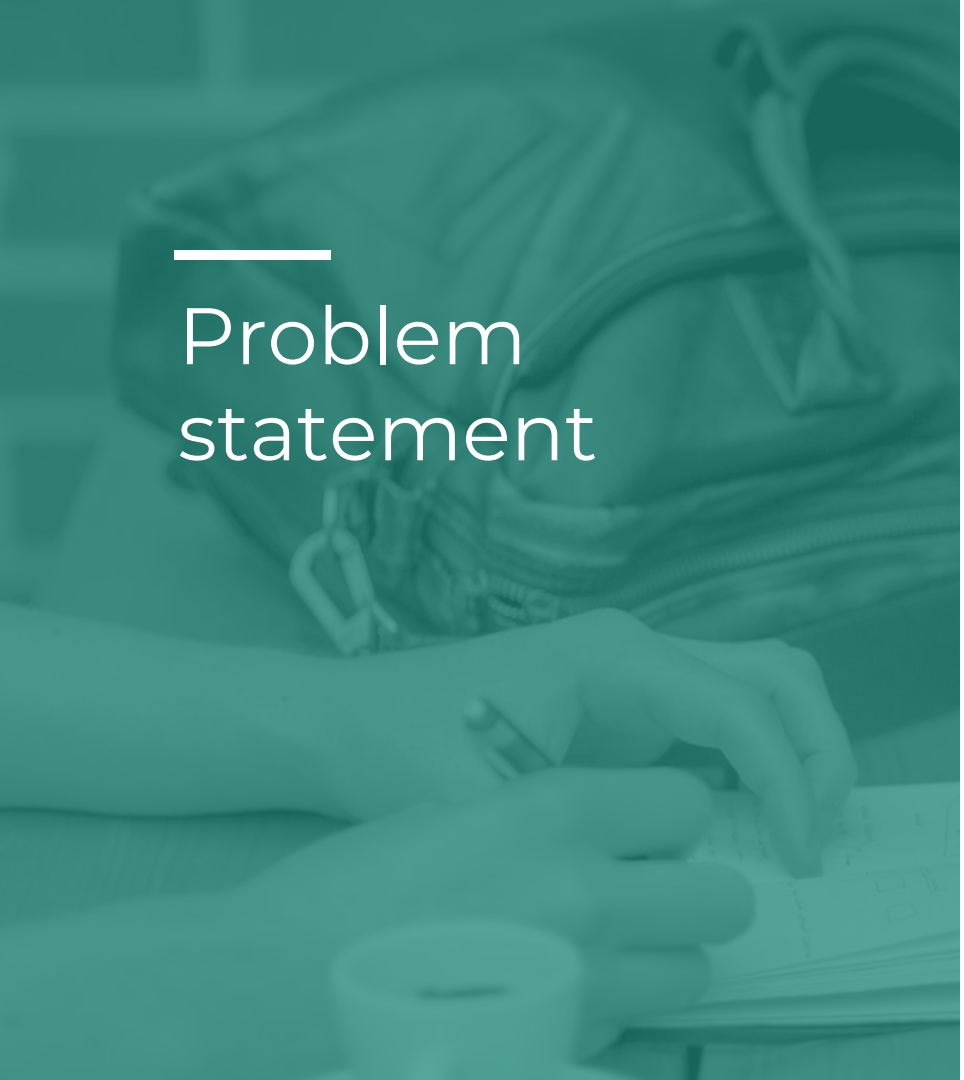

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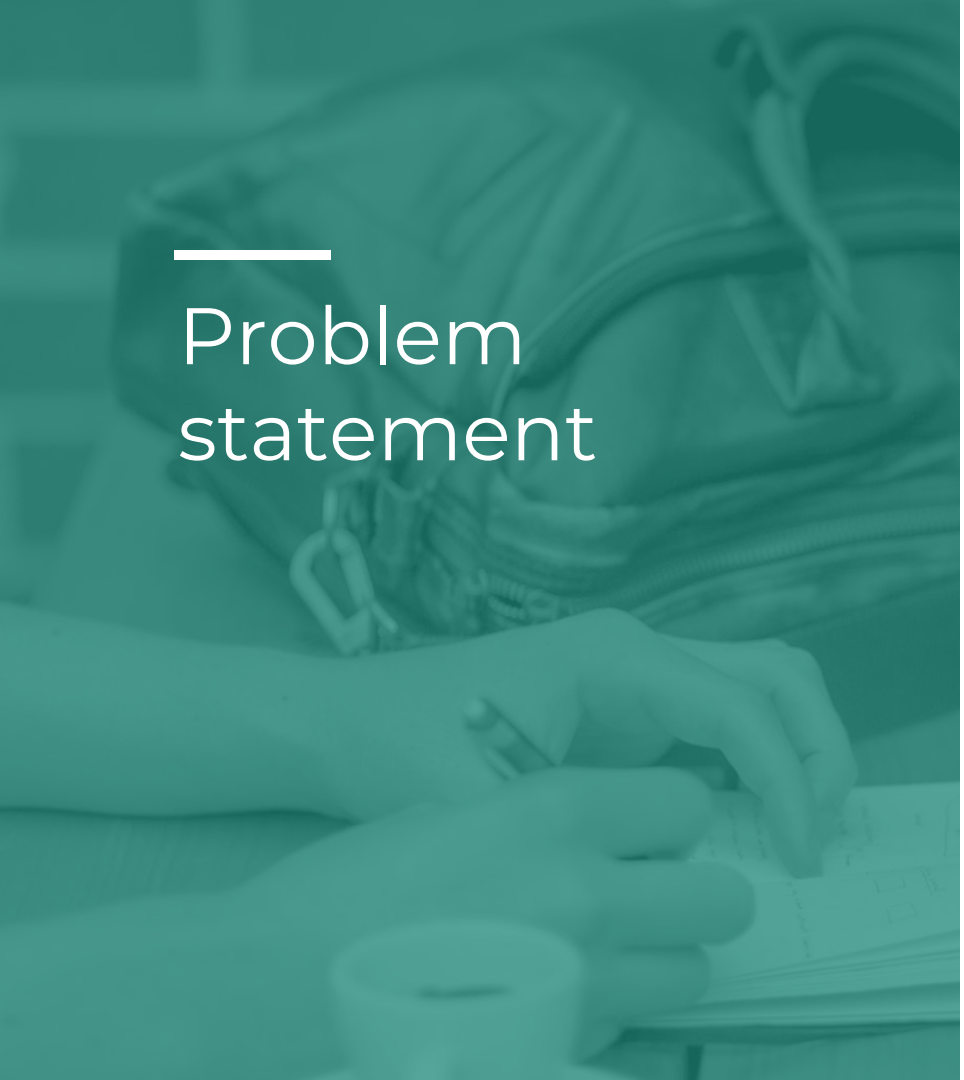

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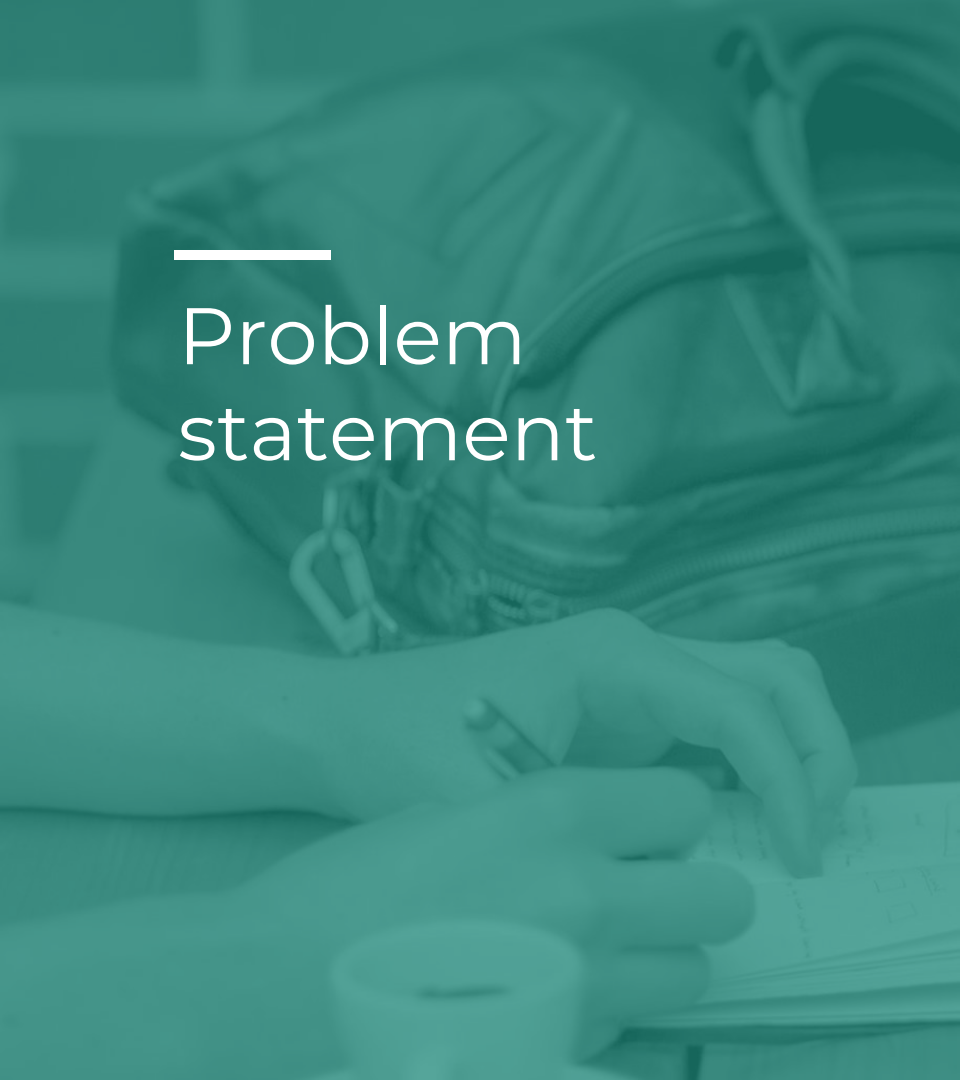

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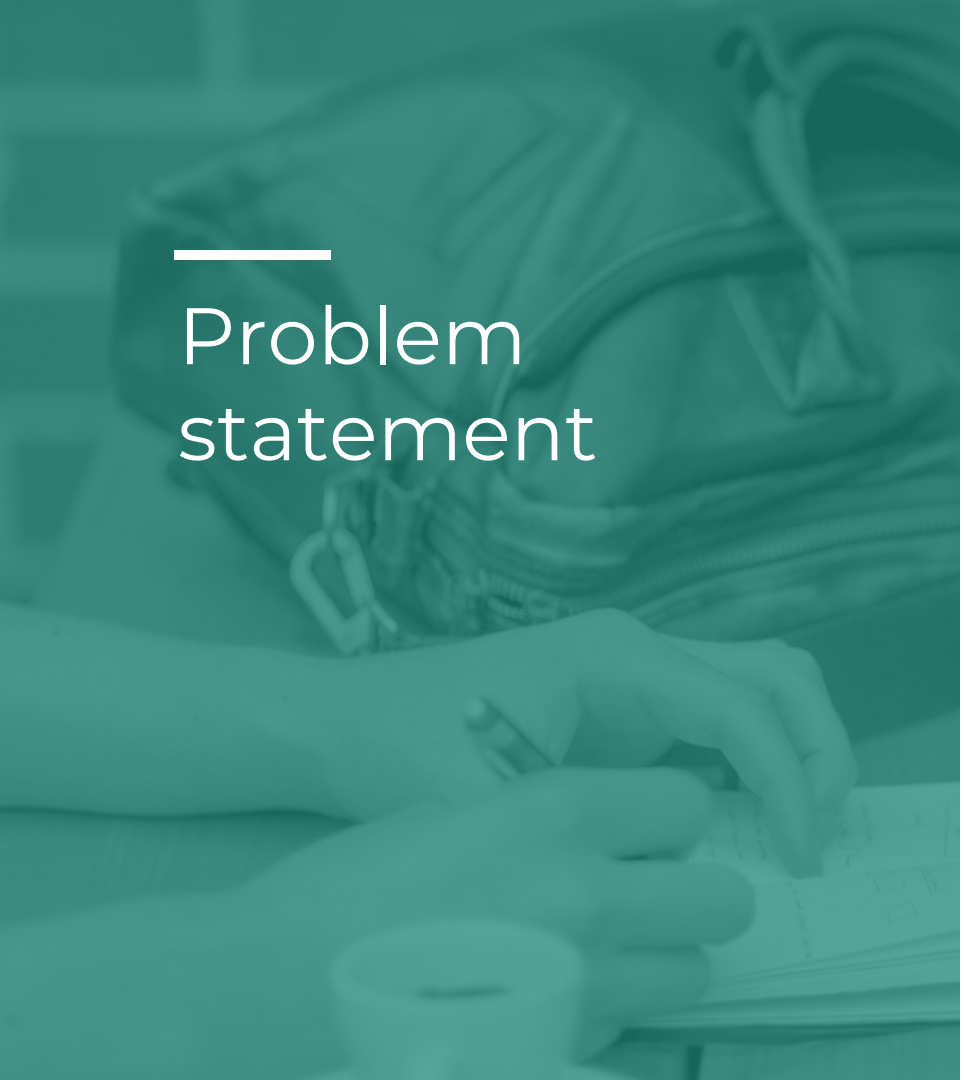

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- To project the states as hotspots and coldspots on the basis of chi-score and z-score

Data Sets

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SO_2, NO_2 and RSPM statistics for all states and cities of India	**Link:** https://www.kaggle.com/shrutibhargava94/india-air-quality-data **Contents:** SO_2, NO_2, RSPM, SPM and PM 2.5 for all the states of India from 1990 to 2015 (csv)
State wise Motor Vehicle statistics	**Link:** http://mospi.nic.in/sites/default/files/statistical_year_book_india_2015/Table-20.4_0. **Contents:** Total registered motor vehicles for each state from 2001 to 2015 (xlsx)
State Wise number of Industries	**Links:** 2008-2014 data (xlsx)- http://www.mospi.gov.in/sites/default/files/statistical_year_book_india_2015/Table%2014.1_1.xlsx 2001-2006 data (docx)- http://labourbureau.gov.in/ASI_V2_2005_06_TAB27F.docx 2007-08 data (pdf)- http://labourbureaunew.gov.in/UserContent/ASI_Vol_1_2007_08.pdf
Census data of india	**Links:** 2001 census (html)- https://censusindia.gov.in/Census_Data_2001/Census_data_finder/A_Series/Total_population.htm 2011 census (xls)- http://mospi.nic.in/sites/default/files/statistical_year_book_india_2015/Table%20

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$$\chi^2 = \sum_{i=1}^{N} \frac{(o_i - E_i)^2}{E_i}$$

Where, o : object is to be tested

o_i : value of o in ith dimension

E_i : mean value on ith dimension among all objects

- A state is considered as outlier if it's p-value is less than level of significance (1%).

Choropleth Map to visualize the results of Chi-Squared Test for the year 2014

https://maurya-bitlegacy.github.io/codename-caeli/Maps/chiscore-map.html

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- To overcome this limitation we used Z-score to find hotspots.

Hotspots using Z-Score

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- To find Z-Score, the Mean Pollutatant Concentration (MPC) for each state is computed, given by:

$$Mean\ Pollutant\ Concentration = \frac{SO_2\ conct. + NO_2\ conct. + RSPM\ conct.}{3}$$

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Since it's very rare that air pollution of a state isn't affected by the increasing air pollution level of it's neighboring state, we have defined a state as hotspot or coldspot taking into consideration the pollution level of it's neighbor.

- A state is Hotspot if : $MPC_{state} > Mean_{neighbor} + \frac{1}{2} std_{neighbor}$
- A state is Coldspot if : $MPC_{state} < Mean_{neighbor} - \frac{1}{2} std_{neighbor}$

Choropleth Map to visualize the results of Z-Score for the year 2014

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Analysis of Results obtained using Z-Score

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- Nagaland and Delhi, both are hotspots, but reasons for that vary. Delhi's pollution levels can be attributed to heavy vehicular emissions, dust from construction sites, etc. Nagaland's pollution levels are much lower, still hotspot as levels more than neighbors. Dust from poorly maintained roads, burning of wastes, some possible reasons.

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- Similarly, Maharashtra's problems revolve around having both huge industry-vehicle concentration as well as every other metro city problem.

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- Chi-Squared Test doesn't use the 'neighbor' statistic unlike Z-score computation and such differences are expected to arise because of that.

Most Polluted Cities in a State

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- Found top 5 most polluted cities in a state.
- Severely Polluted : MPC >=65
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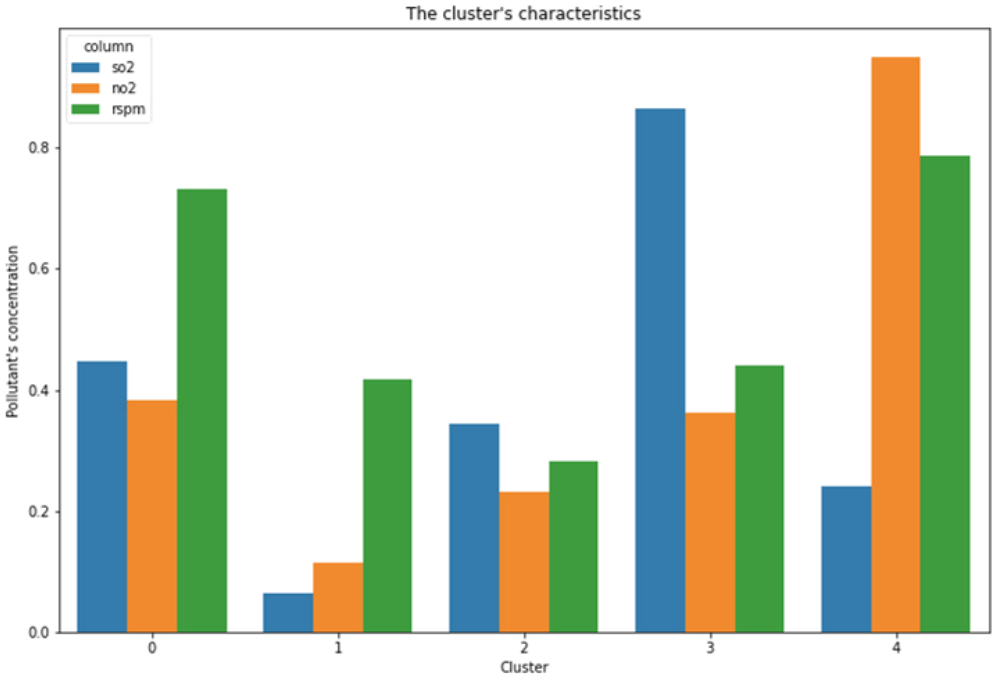

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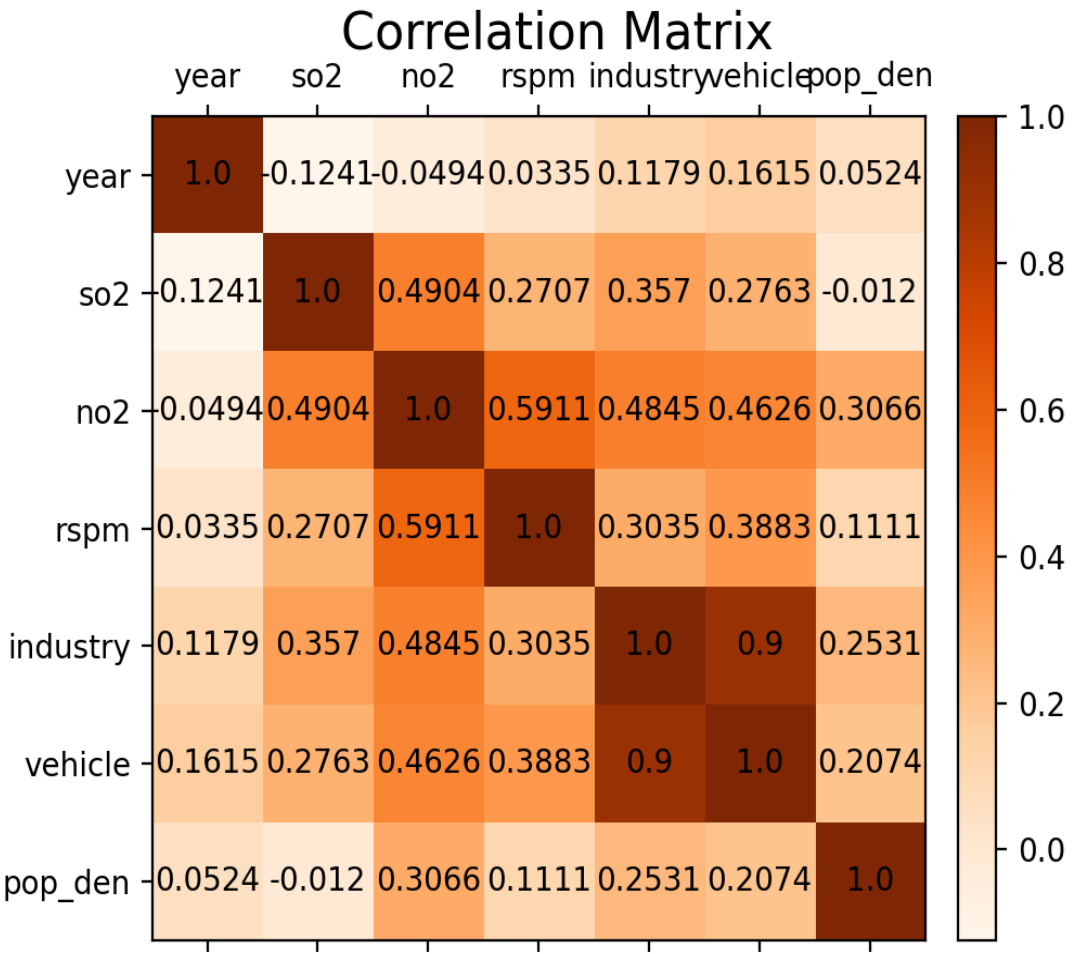

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- For eg., the strong correlation between NO_2 and SO_2 is probably because of some reason which isn't a part of the feature set.

Heatmap of SO_2 concentration for some states

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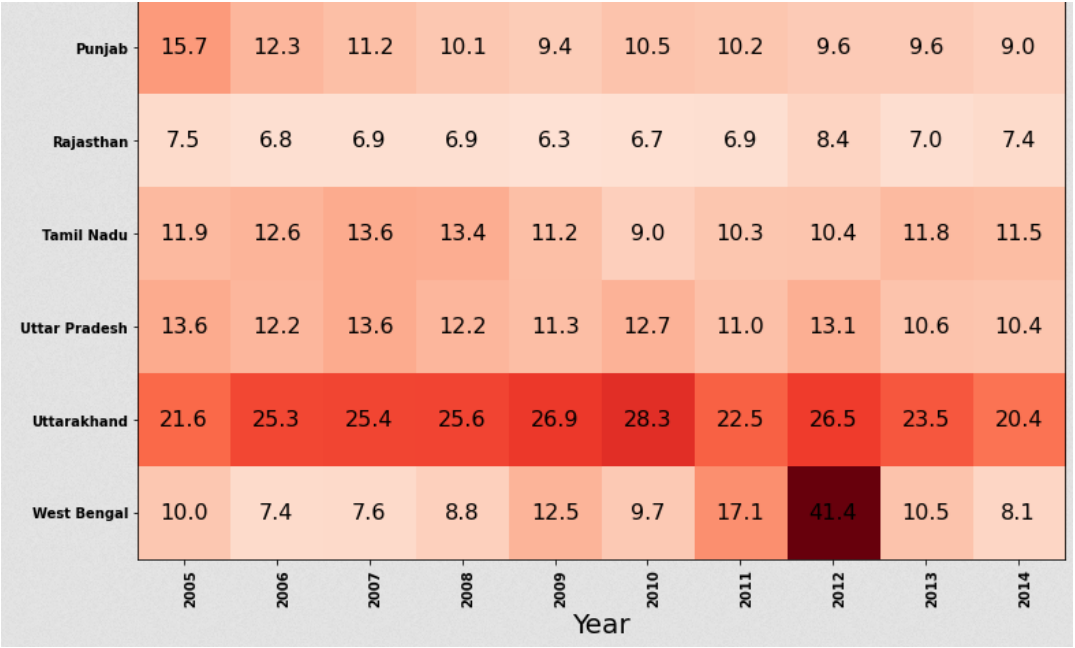

Heatmap of RSPM concentration for some states

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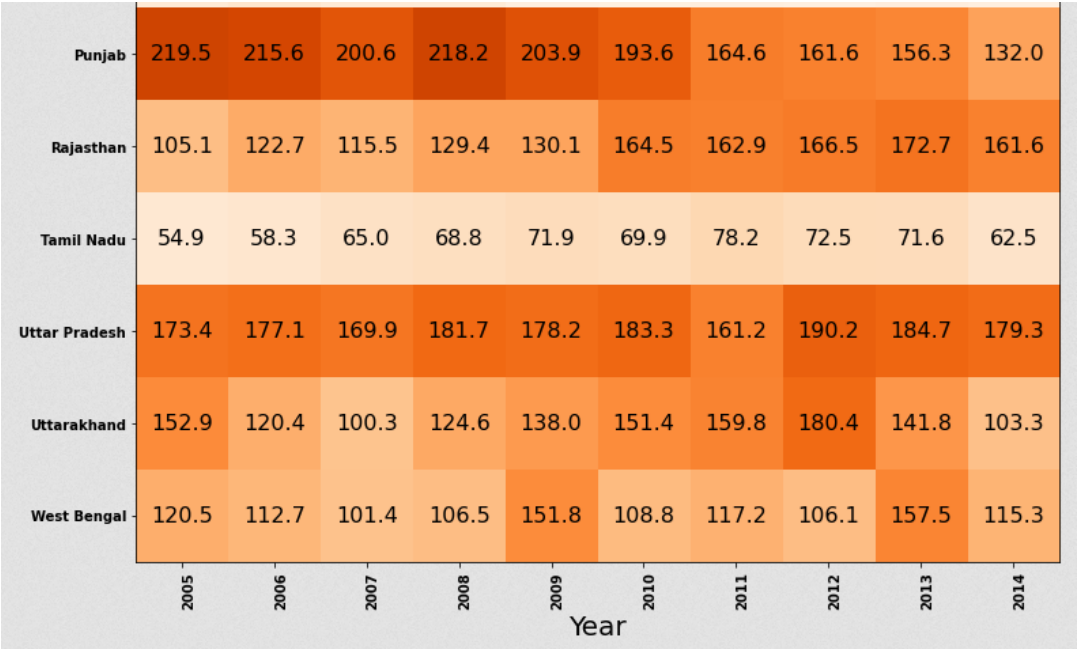

Heatmap of industries for some states

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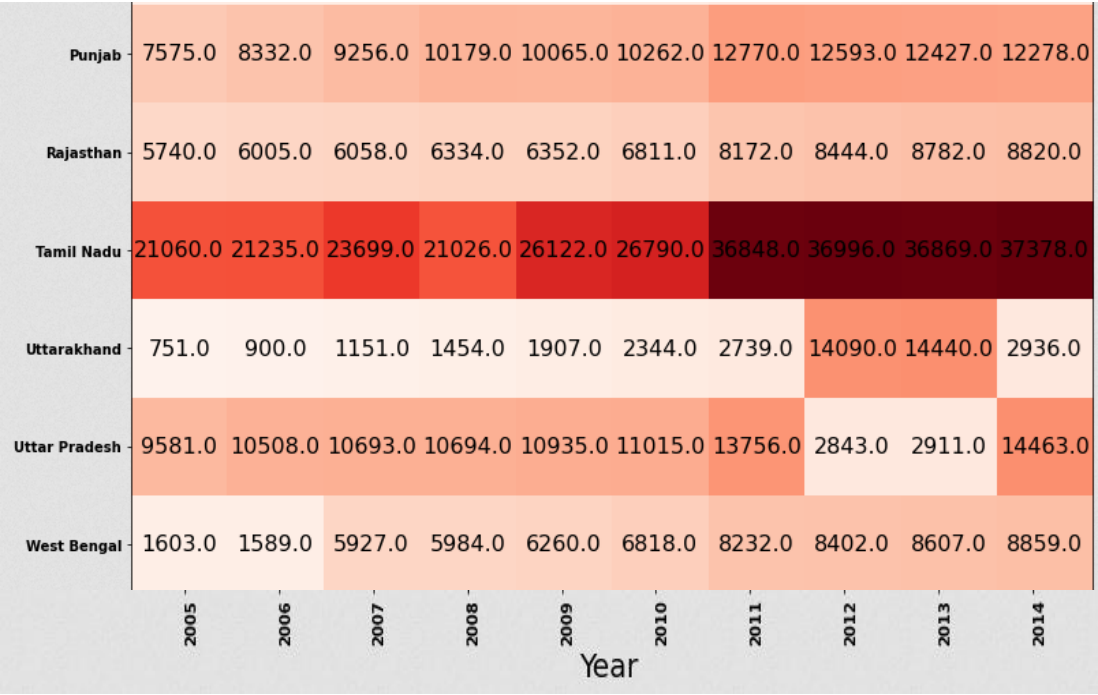

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- The analysis also shows that the presence of the pollutant sulphur dioxide has been high from 2005 to 2008 in some states but has decreased later. Chandigarh, Daman & Diu, Dadra & Nagar Haveli are example of such states.

Thank You