

# Factors Affecting "Air Pollution"

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## Manuscript Details

Available online on <http://www.irjse.in>  
ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

## Cite this article as:

Gole Bhagyashri Manohar . Factors Affecting "Air Pollution", *Int. Res. Journal of Science & Engineering*, January 2018, Special Issue A3 : 151-155.

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## ABSTRACT

The study was carried out over a period of 12 months to get representative data incorporating seasonal variations that have bearing on air quality of Pune city. A total of seven air monitoring stations were installed at various locations. As per the finalized protocol, air quality monitoring for the city of Pune was carried in three sites each with background site common in each set in three seasons. The statistical analysis of the observation of PM<sub>10</sub> is presented. The suggested model can be used for a prediction of the daily mean value of PM<sub>10</sub> using selected factors and their previous values.

**Keywords** Regression, PM<sub>10</sub> (Particulate matter (size < 10 microns)), Pb- Lead content, Cd- Cadmium content, Cu- Copper content, Cr- Chromium content, NO<sub>x</sub>- Nitrogen oxide content, SO<sub>2</sub>- Sulphur dioxide content in PM<sub>10</sub>.

## INTRODUCTION

Air pollution levels are very high in large cities in India. This poses a threat to human health. Causes of air pollution are many, but mostly anthropogenic (i.e. due to human activity). The main anthropogenic factors responsible are, high population density, increasing number of vehicles on road, road dust, factories etc. A study was conducted (in year 2000) to assess relative pollution levels at three sites in Pune. Bhosari is an industrial area, Mandai represents densely populated area and SNTD is a site with crowded road traffic causing emission of toxic gases and large size particulate matter. The observation was recorded in a week. On each

selected day air samples were also taken from university campus. It also has low population density (residential), less vehicle traffic etc. The interest is in checking differences across sites, differences within a day, fluctuations in different seasons etc. It is of interest to study variation not only in total particulate matter but also its break up into different components (metals, gases etc).

**Objectives:**

Three areas of Pune district were studied  
 For this research work. The study covers the following

Objectives: 1. To analyze and examine season wise effect of components on air pollution. 2. To evaluate and forecast the future PM<sub>10</sub> (Particulate matter (size < 10 microns)) of some important polluted element.

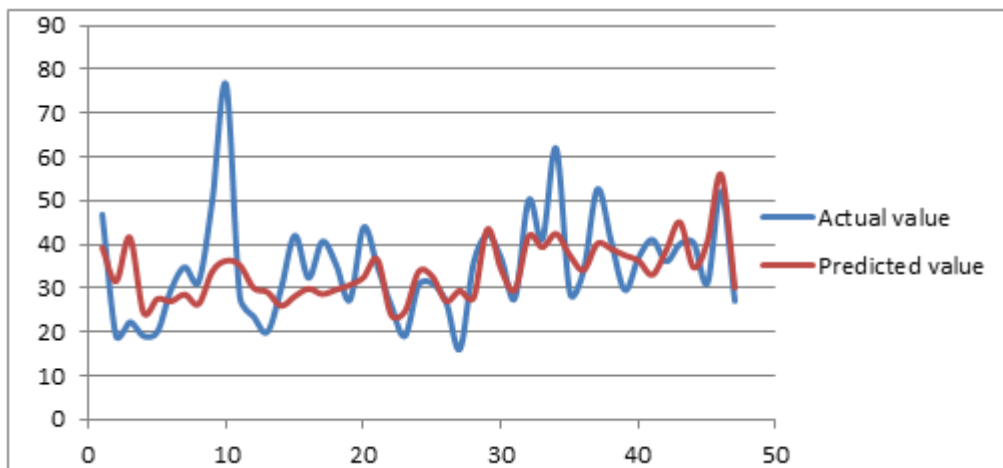
**METHODOLOGY**

The data for the study has been collected from all possible sources as Websites, Online journals, government and cooperative reports etc.

**Table: Analysis and Interpretation of data: Descriptive Statistics of Pb, Cd, Cu, Cr, NOx, SO2**

Variable	N	Mean	Median	StDev	Minimum	Maximum	Q1	Q3
Pb	53	0.912	0.61	0.758	0.07	3.49	0.41	1.09
Cd	53	0.0008	0	0.003	0	0.02	0	0
Cu	53	0.4289	0.21	0.412	0.01	1.44	0.08	0.7
Cr	53	0.46	0.37	0.357	0	1.54	0.2	0.71
NOx	53	47.79	40.07	25.22	17.07	121.46	29.3	59.5
SO2	53	25.11	22.44	10.52	10.15	51.08	17.5	30.8

Forecasting of actual value and predicted value



**Fig. 1:** shows that Actual value and predicted value are approximately equal.

Winter Season

$H_0$ : Data is normally distributed      V/S       $H_1$ : Data is not normally distributed

Decision Criteria: If p-value is less than 0.05 then we reject  $H_0$ .

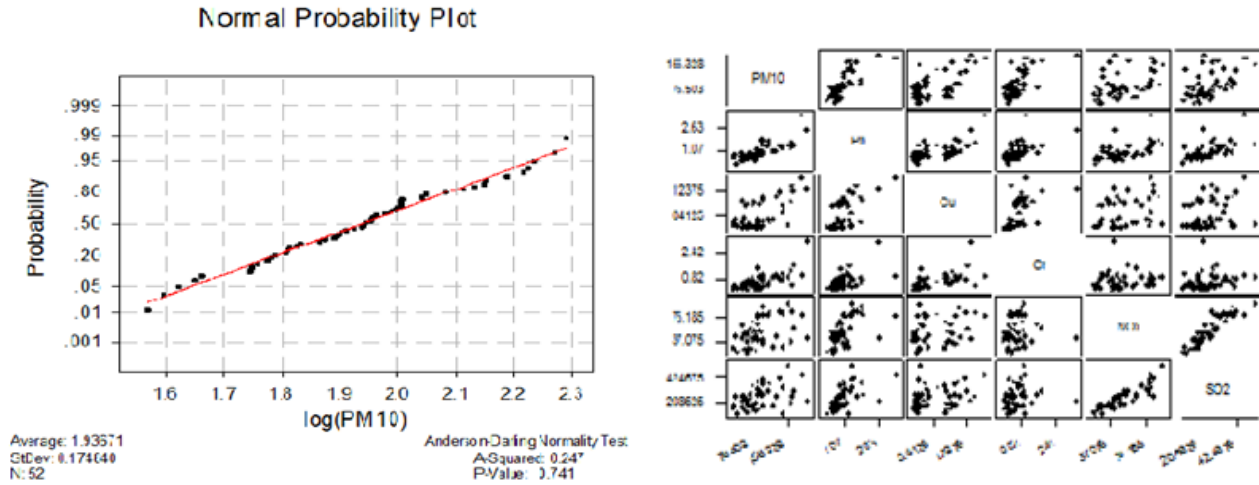


Fig.2a) Matrix Plot of winter season

(fig.2b) shows that  $PM_{10}$  and Pb,  $PM_{10}$  and Cr, NOx and SO2 are positively correlated.

Summer Season

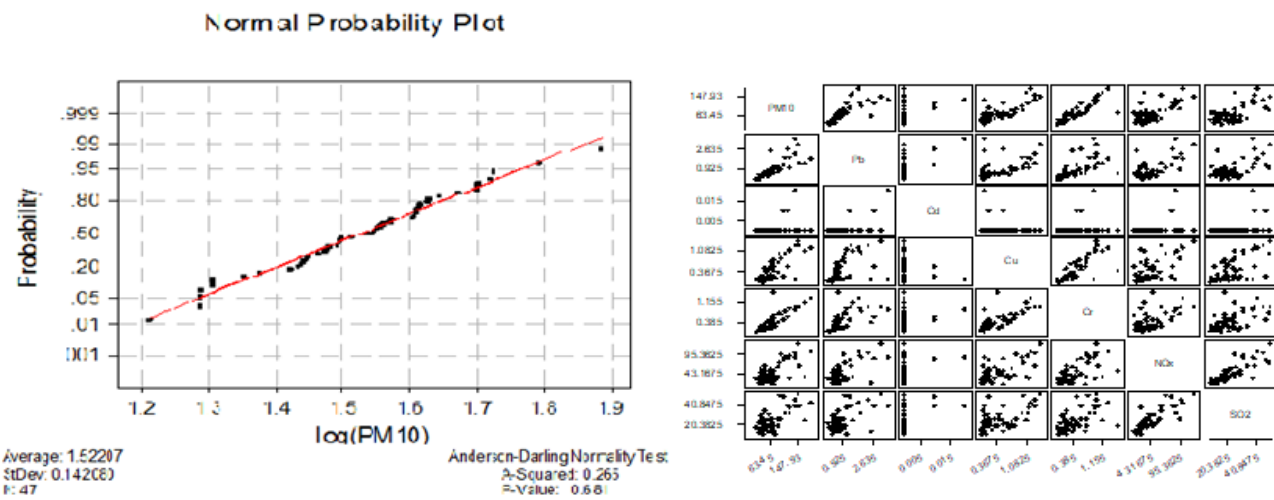


Fig.3 Matrix Plot of Summer season

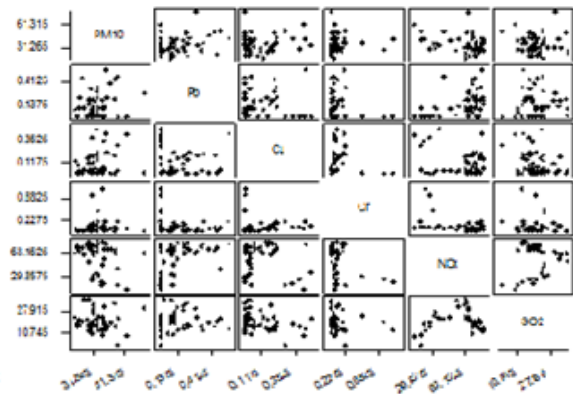
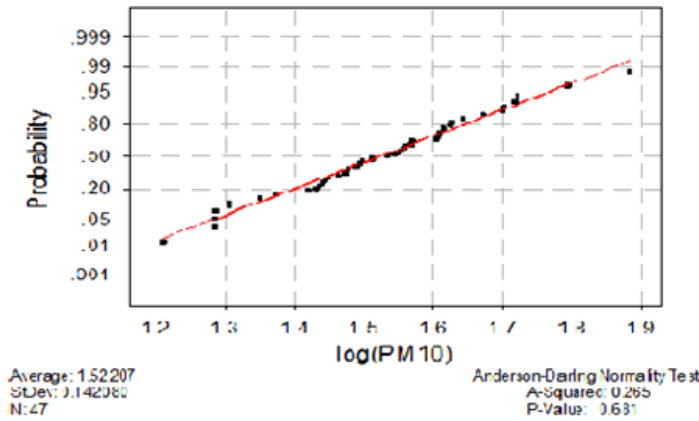
Fig.3) shows that  $PM_{10}$  and Pb, Cu, Cr, NOx and SO2 are positively correlated.

**Monsoon Season**

**H<sub>0</sub>:** Data is normally distributed      **V/S**      **H<sub>1</sub>:** Data is not normally distributed

**Decision Criteria:** If p-value is less than 0.05 then we may reject H<sub>0</sub>.

**Normal Probability Plot**



**(Fig. 4) Matrix Plot of Monsoon season**  
**(Fig. 4) shows that there is no correlation.**

**Stepwise Regression: log (PM<sub>10</sub>) versus Pb, Cu, Cr, NO<sub>x</sub>, SO<sub>2</sub>**

Backward elimination Alpha-to-Remove: 0.1  
 Response is log (PM<sub>10</sub>) on 5 predictors, with N = 52

Step	1	2	3
Constant	1.656	1.655	<b>1.644</b>
Pb	0.115	0.123	<b>0.118</b>
T-Value	2.19	2.55	<b>2.51</b>
P-Value	0.033	0.014	<b>0.015</b>
Cu	0.018		
T-Value	0.35		
P-Value	0.725		
Cr	0.122	0.128	<b>0.127</b>
T-Value	2.72	3.08	<b>3.08</b>
NO <sub>x</sub>	0.0024	0.00255	<b>0.00181</b>
T-Value	1.4	1.54	<b>1.9</b>
P-Value	0.168	0.13	<b>0.064</b>
SO <sub>2</sub>	-0.0017	-0.0021	
T-Value	-0.43	-0.55	
P-Value	0.669	0.587	
S	0.115	0.114	<b>0.114</b>
R-Sq	60.64	60.54	<b>60.28</b>
R-Sq(adj)	56.36	57.18	<b>57.8</b>
C-p	6	4.1	<b>2.4</b>

Season wise content of regressors viz Pb, Cu and Cr is tabulated below

Season	Elements	Average content in atmosphere(µg/m <sup>3</sup> )
Summer	Pb	0.912
	Cu	0.4289
	Cr	0.46
Winter	Pb	1.0248
	Cu	0.4687
Monsoon	Pb	0.1496
	NO <sub>x</sub>	58.72

**Statement of Hypothesis**

H<sub>0</sub>: The data follow a specified distribution.  
 H<sub>1</sub>: The data do not follow a specified distribution.  
 Use the corresponding p-value (when available) to test if the data come from the chosen distribution. If the p-value is less than a chosen alpha (usually 0.05 or 0.10), then reject the null hypothesis that the data come from that distribution.

## Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	2.17665	0.72555	82.05	0.000
Residual Error	48	0.42443	0.00884		
Total	51	2.60107			

$$F_0 = 82.05 \text{ and } F_{\alpha,k,(n-k-1)} = 2.798061$$

The F Ratio table show for 3 degrees of freedom for smaller sum of square, critical value of  $F=2.17665$  at 0.05 level of significance. The computed value, i.e. 82.05 is much greater than table value. Hence it is not significant. Consequently we reject  $H_0$  and accept  $H_1$ . The air quality of pune district is not satisfactory.

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## CONCLUSION

From the analysis of summer season, we conclude that Pb, Cu and Cr highly affect the response variable  $PM_{10}$ . For winter season analysis, it is observed that the response variable  $PM_{10}$  is highly influenced by the regressors Pb and Cu. For monsoon season the regressors Pb and  $NO_x$  significantly affect the response variable  $PM_{10}$ . From the overall analysis, it is seen that the Pb is responsible for air pollution in all season, so we should try to minimize its amount in atmosphere.

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