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Assessment Of Air Quality In The Eastern Industrial Areas Of Thailand Basing On O_3 And PM_{10} Concentrations With DA Model

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Abstract

Discriminant analysis (DA) model was formed to assess the air quality of eastern industrial areas of Thailand. The performance of DA model was then appraised with a correct classification rate (CCR) of cross validation. It indicated the DA model rather well performed to designate air quality in to the proper group with the average CCR 72.63% of cross-validation for overall.

Keywords: Air quality, DA model, CCR

Mathematics Subject Classification: 62J05

INTRODUCTION

The eastern industrial areas of Thailand have been presently confronting to diverse air pollution problems since it is the center of many industrial factories. The two crucial air pollutants, O_3 and PM_{10}, were often informed above the standard level in accordance with [1], [2]. Most of research only aimed at prediction of the one main pollutant particularly O_3 ([3], [4], [5], [6]) or PM_{10} ([7], [8], [9], [10]). However, [11] predicted both of O_3 and PM_{10} concentrations with the MLP models. Few papers worked on another viewpoint like classification of air quality in Thailand, for examples; [12], [13], [14], [15]. This study therefore proposed the statistical multivariate technique through discriminant analysis for classifying air quality of any day into 3 groups based on the standard level of O_3 and PM_{10} concentrations [16] as follows. (1) The good air quality composed of concentrations of O_3 ranged 0-50 ppb. and of PM_{10} varied 0-40 $\mu g/m^3$. (2) The moderate air quality contained the concentrations of O_3 ranged 51-100 ppb. and of PM_{10} varied 41-120 $\mu g/m^3$. (3) The

unhealthy for sensitive air quality consisted of concentrations of O_3 and PM_{10} were greater than 100 ppb. and 120 μg/m^3, respectively.

MATERIALS AND METHODS

The General Education Centre, Mueang District, Chonburi and the Map Ta Phut Health Office, Mueang District, Rayong, represented the monitoring stations in the eastern industrial areas of Thailand. Daily concentrations of 10 air pollutant variables (CO, NO, NO_2, NO_X, SO_2, HC, CH_4, NMHC, O_3 and PM_{10}) and 7 meteorological variables (Pressure, Rain, Relative Humidity: RH, Temperature: Temp, Sun Radiation: SR, Wind Direction: WD and Wind Speed: WS) were measured during 2006-2010. The first step for data analysis was specifying which weather variables influenced to the concentrations of O_3 and PM_{10} by using the coefficient of Pearson correlation. Linear or quadratic function would be applied to determine the DA model. Box's M test statistic is used to test whether the homogeneity of covariance matrices. If the P-value of Box's M test is larger than the predefined significant level, the linear discriminant technique [17] is utilized. Otherwise, the quadratic method [17] is alternated. To appraise the performance of DA model finally, a correct classification rate, one of popular criterions, was used [18] as $CCR = \frac{\sum_{k=0}^{C-1} CC_k}{n}$ where CC_k be the number of correctly allocated observations and n be the number of observation in the considered group.

RESULTS

There were 9 air variables (6 air pollutant variables: CO, NO, NO_2, NO_X, HC and CH_4 and 3 meteorological variables: Pressure, RH and Temp) influenced to the air quality based on the concentrations of O_3 and PM_{10} as seeing of all P-values of Pearson correlation coefficient tests closed to 0. The linear DA was then applied because all the 3 covariance matrices of air quality group were equal as seeing of the large P-value of Box's M statistic. Once the nine influential variables were determined by the discriminant analysis, the estimated linear discriminant function for each of the air quality group was formed as follows:

<u>The good air quality</u>:

$$\hat{Y}_0 = -295.96 + 1.65CO - 0.09NO - 0.2NO_2 - 0.14NO_X + 21.4HC + 25.54CH_4 + 0.06\,Pressure + 1.42RH + 11.78Temp$$

The moderate air quality:

$$\hat{Y}_1 = -286.98 + 5.55CO - 0.22NO - 0.04NO_2 - 0.18NO_X + 20.99HC + 26.82CH_4 + 0.05Pressure + 1.35RH + 11.63Temp$$

The unhealthy for sensitive air quality:

$$\hat{Y}_2 = -301.36 + 8.3CO - 0.87NO - 0.34NO_2 + 0.31NO_X + 21.35HC + 29.34CH_4 + 0.05Pressure + 1.37RH + 11.85Temp$$

The predictive accuracy of DA model was appraised with the CCR and average of CCR illustrated in Table 1.

DISCUSSION

The DA technique entirely displayed an efficient classification of air quality with the average CCR 72.63% of cross-validation. The DA model not only provided the best performance in cross-validation for the good air quality group (CCR=82.72%) but also precisely allocated for the most serious group, the unhealthy for sensitive, with the average CCR 74.07%.

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Table 1: Classification of air quality group

Put into Group	Classification			Classification with Cross-validation		
	True Group			True Group		
	Good	Moderate	Unhealthy	Good	Moderate	Unhealthy
Good	1,257	195	1	1,254	200	2
Moderate	233	376	3	236	371	5
Unhealthy	26	151	23	26	151	20
Total of Obs.	1,516	722	27	1,516	722	27
CCR	0.8291	0.5208	0.8519	0.8272	0.5139	0.7407
Average of CCR	**0.7311**			**0.7263**		

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