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学位論文の要旨（論文の内容の要旨）
Summary of the Dissertation (Summary of Dissertation Contents)

論　文　題　目
Dissertation title

Analyzing and Interpreting Air Quality Monitoring Data in Surabaya

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Air pollution has become a major concern due to its significant impacts on human's health as well as human activities. Many researchers have notified the necessity of fundamental analysis to clarify the cause-effect mechanism of air quality and reflet it into countermeasures to academic researchers, environmental practitioners, stakeholders, as well as residents. In particular, policy makers at both central and local levels in developing countries are required to statistically analyze and interrete air quality monitoring data to take measures and to conduct preventive actions in order to reduce the impacts of the air pollution and ultimately control air quality. This study aimed to propose several methodologies to analyze and interprete air quality monitoring data in Surabaya City, Indonesia.

The dissertation consisted of 7 chapters with the following contents. The overview of current situation, problem statements, research objectives and scopes, and outline of the dissertation were presented in Chapter 1. Chapter 2 contained literature reviews related to air quality analysis and prediction models that have been developed in the air quality research fields. In this study, the air pollution concentrations of six indicators (NO, NO_2, O_3, SO_2, CO and PM_{10}) were continuously collected every 30 minutes for 20 months from February 1, 2001 to September 30, 2002 at five different monitoring stations that had their specific land use patterns in Surabaya. Chapter 3 described the profiles of the monitoring data, and besides, preliminary screening and complementing (missing value imputation) around 15% missing data were carried out.

The following chapters are divided into two parts, those are the intepretation part from Chapters 4 to 5 and the prediction part on Chapter 6. Firstly Chapter 4 employed multilevel model to characterize air pollution behaviors in the city allowing the identification of spatial and temporal variations over the measurements. The result showed that temporal variation highly affected air pollutant concentration. Furthermore, there was an interaction among pollutants and meteorological factors that contributed to the fluctuation of the concentrations. However, it was noted that the spatial variation was small, indicating the the fluctuation and dynamic of concentrations were insignificant because within station factors not due to between station effect.

Chapter 5 attempted to identify temporal patterns of the events in which pollutant concentrations exceeded the ambient threshold (permissible) levels. Since the observed disruption consisted of the complicated mixture of several different ones, Independent Component Analysis (ICA) was employed to decompose into unit distributions caused by emission sources such as traffic, industry and etc. The results could imply some possible policies specific to each monitoring station. By following the above outputs, this study conducted time series analysis with state-space model to find dynamically influencial factors on air pollutant concentration

distributions both using weekly time scale and annual longer time scale in particular cases of NO_2 and PM_{10}. The results provided not only the information of the dynamic factors but also temporal pattern.

The short-term prediction of air quality may take another important role to persuade residents and policy makers to improve their preparedness and change their behavior timely. Therefore, Chapter 6 developed time series models: autoregression model with Bayesian Markov Switching (BMS) model and modified Bayesian Markov Switching (MBMS) model. It was found that MBMS model slightly improved the prediction power with the condition of training data set. Since this kind of model was site-specific, the performance of the model depended of data set on that particular location e.g., the fluctuation. If the training data set was less fluctuate, the Bayesian model performed better than autoregression model. In order to improve the prediction, we used AR and ARIMA models with optimum order (lag-concentrations). We also used longer time interval 4-hour instead of 1-hour. It was observed that the performance of AR and ARIMA with optimum lag information performed better than AR(1) and BMS models. Further, models using 4-hours data were better than models with 1-hour data. To further improve prediction, we tried to predict the true distribution of pollutant by extracting independent components. However, even though the results showed there was a room for improvement to predict distribution of pollutant especially using longer time interval data, the performance was not good. In order to improve the prediction by time series models, this study explored another prediction model that was Generalized Least Square (GLS) model by using original meteorological variables and variables extracted from component analysis. It turned out that the GLS models with original variables would be useful for the short-term prediction of air quality.

Finally, Chapter 7 explored and summarized some remarkable findings from this study. The author promoted some approaches to find possible policies that can be implemented in particular areas. This chapter also discussed some policies based on the assumption of feasibility of implementation. Finally the dissertation made a conclusion of the research and drawed some limitations and future directions.

備考　論文の要旨はＡ４判用紙を使用し，4, 000字以内とする。ただし，英文の場合は1, 500語以内とする。

Remark: The summary of the dissertation should be written on A4-size pages and should not exceed 4,000 Japanese characters. When written in English, it should not exceed 1,500 words.