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Applying land use logistic regression models to assess different levels of air quality and to determine key environmental factors in Taiwan

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Due to fast industrialization and urbanization, air pollution is more and more serious in Taiwan. Generally, many anthropogenic factors can affect air quality; for example, exhaust gas from automobiles and motorcycles, factory emissions, fossil fuels, burning straw, incinerators, etc. The factors are highly associated with land use. Previous studies typically used multiple linear regression model to analyze the relationships between air quality and land use. This study adopts multi-threshold land use logistic regression (LULR) models with several continuous and categorical variables to assess different levels of fine particulate matters ($PM_{2.5}$) in Taiwan and to determine key land-use factors controlling various levels of air $PM_{2.5}$ pollution. First, data on annual air $PM_{2.5}$ pollution in the Taiwan Island are collected in 2017. Four thresholds of 16.37, 18.68, 21.83, 25.83 $\mu\text{g}/\text{m}^3$ are determined based on the 20th, 40th, 60th, and 80th percentiles, respectively, of observed data. Geographical information system is then adopted to analyze data on 29 environmental variables obtained from the three main dimensions—information of land-use categories, amounts of specified pollution sources in townships, and geographical locations adjacent to monitoring stations of air quality. Finally, data in 2017 are employed to establish the LULR model and significant land-use factors causing air $PM_{2.5}$ pollution are determined using stepwise LULR models for various levels of air $PM_{2.5}$ pollution. Moreover, data in 2018 are used to verify the established LULR models. The analyzed results reveal that correct responses of the LULR models range from 83.6% to 100%. For the 20th-percentile threshold, locations and the industry land-use area are positively contributed to air pollution, while tempt densities and building, agriculture, forest land-use areas are negatively contributed to air pollution. For the 40th-percentile threshold, locations, plains with an elevation of less than 150 m, and agriculture land-use areas are related to air pollution. For the 60th-percentile threshold, locations are positively related to air pollution, while forest land-use areas are negatively related to air pollution. For the 80th-percentile threshold, locations and industry park areas associated with air pollution. According to the research results, a feasible strategy of environmental management and outdoor activities is proposed.