Bayesian modelling for estimating adverse health effects of exposure to multiple air pollutants in a time series framework

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The effects of ambient air pollution on population health have been investigated historically through a single-pollutant approach, mainly using regression-based techniques, where the co-pollutants have been treated as modifying or confounding factors. Polluted air, however, contains a complex mixture of particles with a range of physical and chemical properties, gases, bioareosols and toxic substances. Estimation of how simultaneous exposure to multipollutants affects the risk of adverse health response represents a challenge for scientific research and air quality management. In this work we consider the problem of modelling these multipollutant systems within the framework of time series studies. We propose a nonparametric Bayesian approach, using a Dirichlet process mixture, defined by a stick-breaking construction, to cluster time points with similar moltipollutant and response profiles. We evaluate the inclusion of smooth nonlinear functions to account for aspects associated with time variation such as trend and seasonality. Inference is carried out via Markov Chain Monte Carlo methods, fitting joint models for exposures to pollutants and models for health responses. The applicability of our approach and the comparison with benchmark statistical techniques is evaluated in a real data set which comprises daily time series of a range of particle metrics, meteorological variables and cardiovascular mortality counts for London (UK) for the years 2002-2005.

Key Words: Bayesian nonparametrics, clustering daily profiles, multipollutant mixtures