The University of Chicago
Department of Statistics
Ph.D. Seminar

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**"Two Problems in Environmetrics"**

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## ABSTRACT

The first part of this thesis presents a new approach to emission scenario analysis using simplified Chemical Transport Models (CTM). Typically, CTM runs are highly time consuming, so obtaining fast and accurate approximations to some of their outputs is desired. We present two methods that closely approximate the ammonia wet deposition output from the Community Multiscale Air Quality (CMAQ) model by combining the CMAQ output under a base emission scenario and a few runs of a simplified model. We obtained the simpler model of CMAQ by switching off all the chemistry and only allowing ammonia to undergo physical transport and dry and wet deposition. This simplified version called here Tracer model runs 40 times faster than the full model. The second method uses a source receptor matrix and the base CMAQ run to get good approximations for any new emission scenario. We apply our methods to solve the inverse problem of correcting ammonia emissions based on observations.

The second part proposes a semiparametric method to estimate spectral densities of isotropic Gaussian processes with scattered data. We model the spectral density function (Fourier transform of the covariance function) with a linear combination of B-splines up to a cutoff frequency and, from this point, a truncated algebraic tail. We calculate an analytic expression for the covariance function and tackle several numerical issues that arise when calculating the likelihood. We maximize the likelihood using the simulated annealing method. We compare our method with a kernel method proposed by Hall et al.(1994) and a parametric method using Matern model. Our simulations results show that our method outperforms the other two by several criteria. Our method directly estimates the tail behavior of the spectral density, which has the biggest impact on interpolation properties, and takes fully into account the correlations between observations through the use of the likelihood.