MICHIGAN STATE UNIVERSITY
Department of Statistics and Probability

COLLOQUIUM

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Multivariate Spatial Modeling of Conditional Dependence to Study Arsenic Contamination

Tuesday, November 11
10:20 a.m. - 11:10 am
Refreshments 10:00 am
C405 Wells Hall

Abstract

Elevated concentrations of toxic trace elements, such as arsenic, pose threats to human health through contamination of drinking water. Toxic trace elements are regulated in part by soils. We describe an experiment to study the reactivity of arsenic in soils, by mapping the composition of elements on a sand grain using X-ray fluorescence analyses, before and after the grain is treated with arsenic, resulting in multivariate spatial maps of elemental abundance. To understand the behavior of arsenic in soils, it is important to disentangle the multivariate relationships among the elements in the sample. The abundance of most elements, including arsenic, correlates strongly with that of iron, but conditional on the amount of iron, some elements may mitigate or potentiate the accumulation of arsenic. This problem motivates our work to define conditional correlation in spatial lattice models and give general conditions under which two components are conditionally uncorrelated given the rest. We apply our results to big X-ray datasets introducing new circulant-embedding based and computational efficient likelihood algorithms. More specifically, we present periodic covariance approximations designed for embedding covariance matrices for lattice-located observations inside of nested block circulant covariance matrices. The proposed approximations are positive definite provided that the embedding lattice is at least as large as the observation lattice, in contrast with standard circulant embedding methods that require the embedding lattice to be at least twice the size of the observation lattice in each dimension.

*Joint work with Joe Guinness