

STATISTICS COLLOQUIUM

MONDAY, SEPTEMBER 19, 2011

TALK: 4:00 PM — SCIENCE CENTER RM. 309

RECEPTION: 5:15 PM — SCIENCE CENTER, 7TH FLOOR

“Transformed Gaussian Markov Random Fields and Spatial Modeling”

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ABSTRACT

The Gaussian random field (GRF) and the Gaussian Markov random field (GMRF) have been widely used to accommodate spatial dependence under the generalized linear mixed model framework. These models have limitations rooted in the symmetry and thin tail of the Gaussian distribution. We introduce a new class of random fields, termed transformed GRF (TGRF), and a new class of Markov random fields, termed transformed GMRF (TGMRF). They are constructed by transforming the margins of GRFs and GMRFs, respectively, to desired marginal distributions to accommodate asymmetry and heavy tail as needed in practice. The Gaussian copula that characterizes the dependence structure facilitates inferences and applications in modeling spatial dependence. This construction leads to new models such as gamma fields and beta fields with Gaussian copulas, possibly Markov, which can be used to model, for instances, Poisson intensity or Bernoulli rate in a generalized linear mixed model. Some properties of the new random fields are studied. The method is naturally implemented in a Bayesian framework.

We illustrate the utility of the methodology in an ecological application with spatial count data and spatial presence/absence data of some snail species, where the new models are shown to outperform the traditional spatial models. The validity of Bayesian inferences and model selection are assessed through simulation studies for both spatial Poisson regression and spatial Bernoulli regression.

Joint with Marcos O. Prates, Michael R. Willig and Jun Yan.