A Bayesian Nonparametric Spiked Process Prior for Dynamic Model Selection

Michele Guindani, Ph.D.
Associate Professor in the Department of Statistics
University of California, Irvine

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ABSTRACT:

In many applications, investigators monitor processes that vary in space and time, with the goal of identifying temporally persistent and spatially localized departures from a baseline or "normal" behavior. In this manuscript, we consider the monitoring of pneumonia and influenza (P&I) mortality, to detect influenza outbreaks in the continental United States, and propose a Bayesian nonparametric model selection approach to take into account the spatio-temporal dependence of outbreaks. More specifically, we introduce a zero-inflated conditionally identically distributed species sampling prior which allows borrowing information across time and to assign data to clusters associated to either a null or an alternate process. Spatial dependences are accounted for by means of a Markov random field prior, which allows to inform the selection based on inferences conducted at nearby locations. We show how the proposed modeling framework performs in an application to the P&I mortality data and in a simulation study, and compare with common threshold methods for detecting outbreaks over time, with more recent Markov switching based models, and with other Bayesian nonparametric priors that do not take into account spatio-temporal dependence.