STATISTICS COLLOQUIUM

MONDAY, SEPTEMBER 15, 2008
Talk: 4:00 PM – *Science Center 309*
Reception: 5:15 PM – *Science Center, 7th Floor*

"Two Topics in Nonparametric Statistics"

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ABSTRACT

In the first part of this talk, we analyze sequences of arrival data that follow doubly stochastic Poisson processes. Such types of data have been produced recently in numerous fields, including biophysics, neuroscience and astrophysics. In contrast to a standard Poisson process, a doubly stochastic Poisson process has stochastic arrival rates, which relate to underlying stochastic dynamics of interest, for example, a protein's conformational dynamic in biophysics. Complementing existing parametric methods, we consider nonparametric inference for stochastic arrival rates, paying particular attention to their autocorrelation structure. We introduce a kernel method to reconstruct the arrival rates from the Poisson data, and to estimate the autocorrelation function. This kernel method is model-free, and offers wide-ranging applicability. We consider both practical implementation and theoretical properties of the method, illustrating through simulated examples as well as the analysis of real photon arrival data from single-molecule experiments in biophysics.

In the second part of this talk, we examine nonparametric hierarchical Bayes procedures that employ a Bernstein-polynomial-based prior, i.e., the Bernstein-Dirichlet process, for analyzing binomial data. Under this setting, the Bernstein polynomial serves as a kernel smoothing of the Dirichlet process, and the predictive density of a future binomial observation can be expressed as a mixture of beta densities, which is absolutely continuous, in contrast to the discrete probability measure drawn from a Dirichlet process. We illustrate through examples that those nonparametric Bayes estimates based on the Bernstein-Dirichlet process are more robust to sample variation and tend to have smaller estimation errors than those based on the Dirichlet process. In certain settings, the new estimators can even outperform Stein's estimator and Efron and Morris' limited translation estimator.