Title: State Space (Dynamic) Models of Count Data and Applications

Abstract: We introduce and develop a class of Poisson-based count time series models that allow fast online sequential updating, monitoring, and forecasting. These classes of models are designed to account for serial (temporal) dependence in the counts that are exposed to a dynamically changing random common environment. The base model is termed Poisson-Gamma State Space (PGSS) due to the state transition densities having Gamma forms. Extensions such as the incorporation of covariates, incorporation of multivariate count data series, and the development of highly adaptable state augmentation to sudden burst in the counts are discussed. To estimate model parameters in a sequential and fast manner, several methods are developed using Markov chain Monte Carlo (MCMC) and particle-based algorithms. To illustrate the use of these count data models, several business analytics applications such as call center volume management, consumer demand prediction, ride-sharing demand monitoring, and web-click updating are discussed.