

Title: Sequential Modeling, Monitoring, and Forecasting of Streaming Web Traffic Data

Abstract

In this paper, we introduce strategies for modeling, monitoring, and forecasting sequential web traffic data using flows from the Fox News website. In our analysis, we consider a family of Poisson gamma state space (PGSS) models that can accurately quantify the uncertainty exhibited by web traffic data, can provide fast sequential monitoring and prediction mechanisms for high frequency time intervals, and are computationally feasible when structural breaks are present. As such, we extend the family of PGSS models to include the state augmented (sa-)PGSS model whose state evolution structure is flexible and responsive to sudden changes. Such adaptability is achieved by augmenting the state vector of the PGSS model with an additional state variable for a time-varying discount factor. We develop an efficient particle-based estimation procedure that is suitable for sequential analysis, allowing us to estimate dynamic state variables and static parameters via closed-form conditional sufficient statistics. We compare the performance of the PGSS family of models against viable alternatives from the literature and argue that – especially in the presence of structural breaks – our proposed approach yields superior sequential model fit and predictive performance while preserving computational feasibility. We provide additional insights by designing a simulation study that mimics potential web traffic data patterns.