Hierarchical statistical modeling of influenza-epidemic dynamics in space and time

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Abstract

An infectious disease typically spreads via contact between infected and susceptible individuals. Since the small-scale movements and contacts between people are generally not recorded, available data regarding infectious disease are often aggregations in space and time, yielding small-area counts of the number infected during successive, regular time intervals. In this paper, we develop a spatially descriptive, temporally dynamic hierarchical model to be fitted to such data. Disease counts are viewed as a realization from an underlying multivariate autoregressive process, where the relative risk of infection incorporates the space-time dynamic. We take a Bayesian approach, using Markov chain Monte Carlo to compute posterior estimates of all parameters of interest. We apply the methodology to an influenza epidemic in Scotland during the years 1989-1990.