MATHEMATICS DEPARTMENT SEMINAR

Population-Level Bayesian Forecasting of Clinical Outcomes Caused by Infectious Diseases

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2:10 PM TO 3:00 PM

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Abstract

Forecasting healthcare utilization is a critical task for public health crises caused by infectious diseases. Various statistical methods have been used for this, e.g., time series models, machine learning, and Bayesian semi-mechanistic models. These methods usually use clinical testing data, which are prone to sampling biases and unaccounted changes in the reporting rates. Wastewater pathogen surveillance offers a more robust assessment of infection dynamics, but has not been tested, especially in the context of Bayesian semi-mechanistic modeling and forecasting. In this work, we develop a Bayesian semi-mechanistic model that integrates wastewater surveillance and hospitalization data to produce probabilistic forecasts of hospital demand, and jointly infers the effective reproduction number (Rt). The methods we develop employ both compartmental-based processes (to describe evolution of latent infections, and other disease states) and Bayesian nonparametrics (to infer time-varying quantities: the effective reproduction number and hospitalization probability). We demonstrate that our model can jointly nowcast Rt and forecast hospitalization, and we validate the Rt inference using a simulation study. We apply our model to both incidence and prevalence hospitalization data for the state of California and select California counties and compare performance of our new forecasting method against multiple competing methods.

STUDENTS ARE WELCOME!