BIOSTATISTICS SEMINAR

Online Estimation of Optimal Treatment Allocations for Control of an Emerging Infectious Disease

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Emerging infectious diseases are responsible for high morbidity and mortality, economic damages to affected countries, and are a major vulnerability for global stability. Technological advances have made it possible to collect, curate, and access large amounts of data on the progression of an infectious disease. We derive a framework for using this data in real-time to inform disease management.

We formalize a treatment allocation strategy as a sequence of functions, one per treatment period that map up-to-date information on the spread of an infectious disease to a subset of locations for treatment. An optimal allocation strategy optimizes some cumulative outcome, e.g., the number of uninfected locations, the geographic footprint of the disease, or the cost of the epidemic. Estimation of an optimal allocation strategy for an emerging infectious disease is challenging because spatial proximity induces interference among locations, the number of possible allocations is exponential in the number of locations, and because disease dynamics and intervention effectiveness are unknown at outbreak. We derive a Bayesian online estimator of the optimal allocation strategy that combines simulation-optimization with Thompson sampling. The proposed estimator performs favorably in simulation experiments. This work is motivated by and illustrated using data on the spread of white-nose syndrome, a highly fatal infectious disease devastating bat populations in North America.

The Johns Hopkins Bloomberg School of Public Health
Department of Biostatistics, Monday, September 12, 2016, 12:15-1:15
Room W2008 (Refreshments 12:00pm)

Note: Taking photos during the seminar is prohibited

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