Modeling the detection of Influenza Outbreaks: going from temporal to spatio-temporal models

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Abstract: The development of statistical algorithms for the automated monitoring of influenza surveillance data is one of the most challenging objectives of epidemiological surveillance systems. In this talk we firstly review an approach for determining the epidemic and non epidemic periods from influenza surveillance data by modeling the process of differenced incidence rates. Bayesian inference is carried out to detect influenza epidemics at the very moment of their onset. As the model provide the probability of being in an epidemic state at any given moment, we also briefly review a practical implementation of the methodology. This has been done using a client-server architecture with a web-based client application design, which allows users to introduce and edit their own data and obtain information about the possibility of their system being in an epidemic phase. A natural spatio-temporal extension of this method for detecting influenza outbreaks will be introduced in the second part of the talk. Our proposal assumes, for every geographical unit, two different possible states for the di- fferenced weekly incidence rates of influenza. These states are a white noise process for the non-epidemic phase and a first order temporal auto-regressive process with spatially structured increments for the epidemic phase. A Markovian structure is used to estimate the probability of being in any of the two states for each location and week. Other options for the parametrization are discussed, and their performance is shown on a real dataset of the United States from Google Flutrends.
