School of Engineering and Applied Science (SEAS), Ahmedabad University

BTech(ICT) Semester IV: Probability and Random Processes (MAT202)

Special Assignment Abstract

Date: February 14, 2019 (Thursday)

- Area: Biology
- Group Members:
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  ◦ Background:
  We propose a class of mathematical models for the transmission of infectious diseases in large populations. This class of models, which generalizes the existing discrete-time Markov chain models of infectious diseases, is compatible with efficient dynamic optimization techniques to assist real-time selection and modification of public health interventions in response to evolving epidemiological situations and changing availability of information and medical resources. While retaining the strength of existing classes of mathematical models , the proposed models possess two advantages over previous models: (1) these models can be used to generate optimal dynamic health policies for controlling spreads of infectious diseases, and (2) these models are able to approximate the spread of the disease in relatively l arge populations with a limited state space size and computation time.

  ◦ Importance of Topic: The appearance of novel human pathogens (e.g. H1N1) and the persistent circulation of infectious diseases in communities (e.g. HIV and tuberculosis), have stimulated efforts to develop dynamic health policies for controlling the spread of infectious diseases. Most existing approaches for identifying optimal policies for infectious disease control use mathematical or simulation models of disease spread as a basis for comparing the performance of a number of pre-determined health policies.

  ◦ Inference:
    - What exactly we are going to do:
    - Step 1: Define the classes and form the dynamics state equation
    - Step 2: Find the joint probability distribution of the driving events.
    - Step 3: Form the dynamics driving and feasibility constraints.
    - Step 4: Calculate the transition probability matrix for the Markov chain (XC1(t), . . . , XCM(t)): t = 1, 2, . . .

  ◦ References:

    1. 1) https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/j.2041-210X.2010.00018.x
    2. 2) https://academic.oup.com/ije/article/30/5/1078/724183
    3. 3) https://repository.up.ac.za/bitstream/handle/2263/27956/dissertation.pdf;sequence=1