Spatial Epidemics Dynamics: Synchronization

Mathematics 4MB3/6MB3

Mathematical Biology

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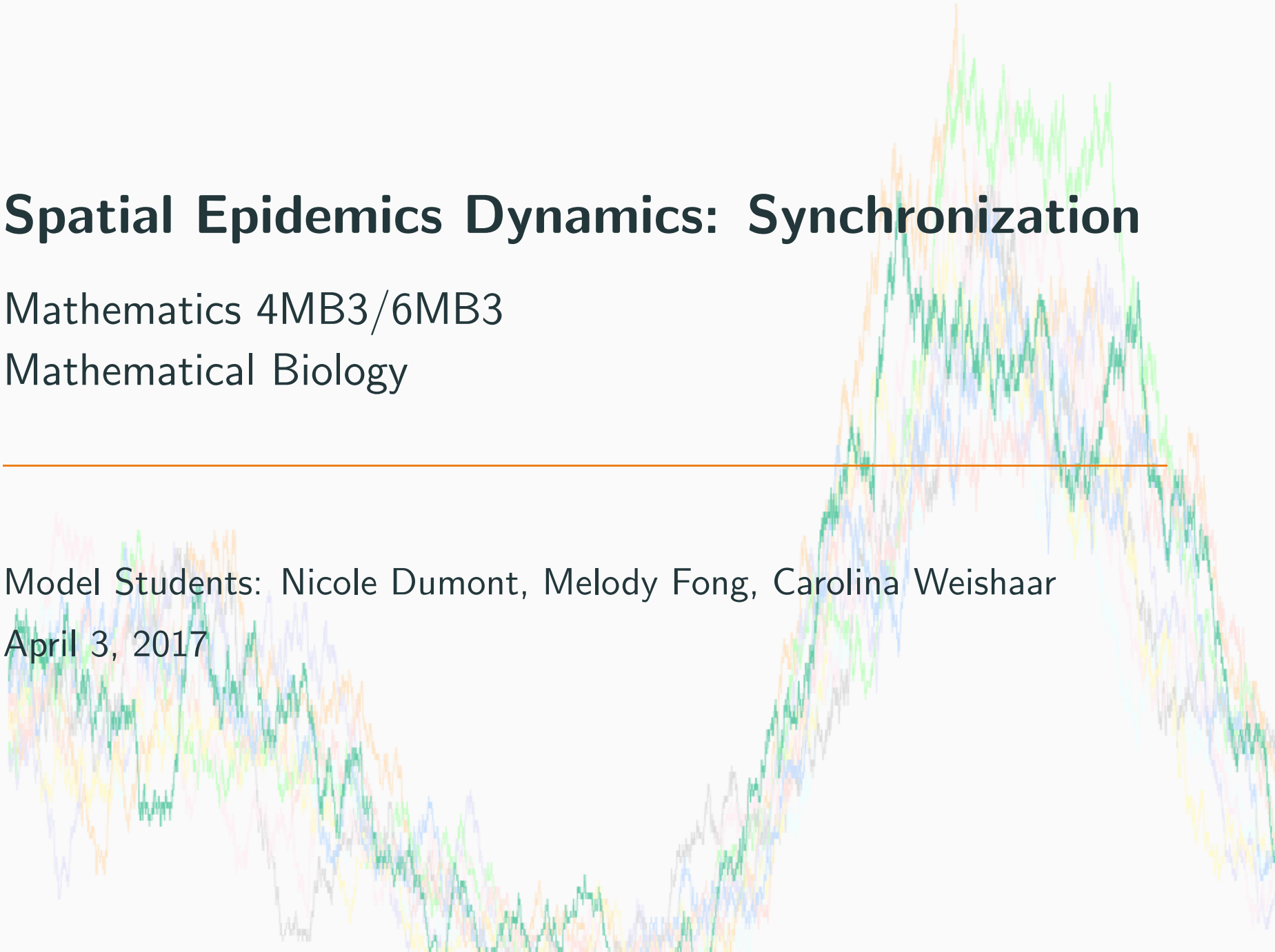

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Introduction

Diseases are fun

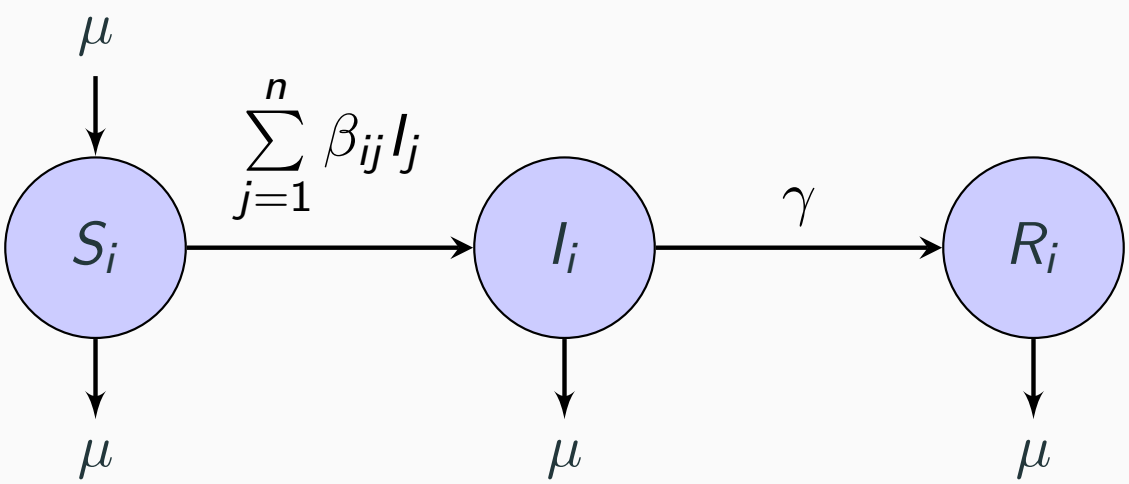
Text goes here

Diseases are cool

Text goes here

Methods

SIR Model for a Single Patch



$$\frac{dS_i}{dt} = \mu - S_i \sum_{j=1}^{n} \beta_{ij}(t) I_j - \mu S_i$$

$$\frac{dI_i}{dt} = S_i \sum_{j=1}^{n} \beta_{ij}(t) I_j - \gamma I_i - \mu I_i$$

$$\frac{dR_i}{dt} = \gamma I_i - \mu R_i$$

Beta Matrix

$$\beta(t) = \langle\beta\rangle\,(1 + \alpha\cos(2\pi t))M$$

Equal Coupling Matrix:

$$M = \begin{bmatrix} 1-m & \frac{m}{n-1} & \frac{m}{n-1} & \frac{m}{n-1} & \cdots \\ \frac{m}{n-1} & 1-m & \frac{m}{n-1} & \frac{m}{n-1} & \\ \frac{m}{n-1} & \frac{m}{n-1} & 1-m & & \\ \vdots & & & \ddots & \end{bmatrix}$$

Nearest Neighbour Matrix:

$$M = \begin{bmatrix} 1-m & \frac{m}{2} & 0 & 0 & \cdots & \frac{m}{2} \\ \frac{m}{2} & 1-m & \frac{m}{2} & 0 & & \vdots \\ 0 & \frac{m}{2} & 1-m & & & \\ 0 & 0 & & \ddots & & \\ \vdots & & & & \ddots & \frac{m}{2} \\ \frac{m}{2} & & & \cdots & \frac{m}{2} & 1-m \end{bmatrix}$$

Results

Deterministic Model

Deterministic Model

- first item

Stochastic: Gillespie Model

Stochastic: Adaptive Tau Algorthim

Period Diagram/Bifurcation

Coherence dependence on Parameters