



Case Study: Mathematical Modeling of Seasonal Influenza

Omar Saucedo, Assistant Professor, Mathematics

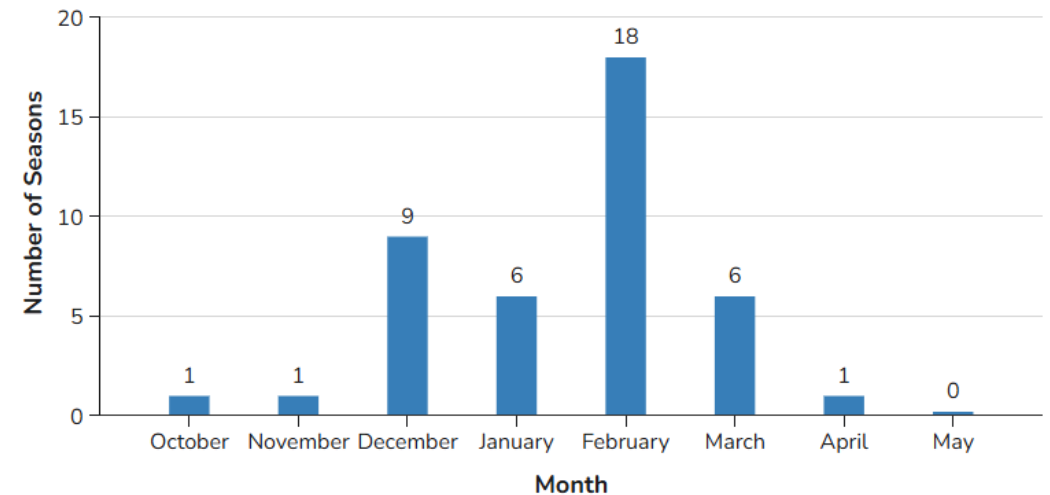
May 31st, 2026



Seasonal Influenza Background

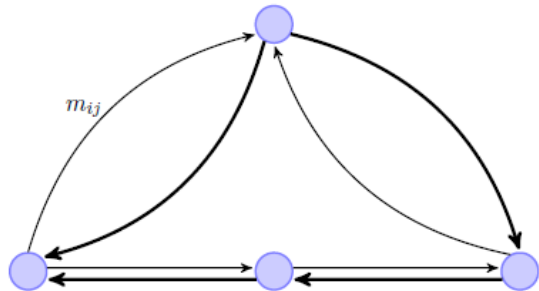
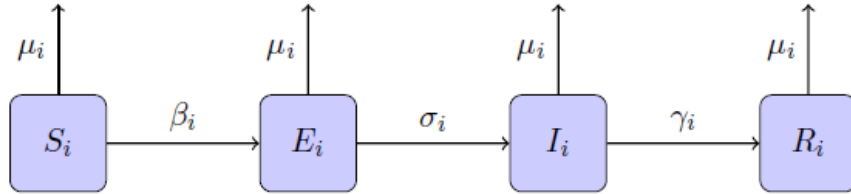
- Seasonal influenza is a respiratory infection that is caused by the influenza virus.
- There are four types of influenza viruses (A, B, C, and D). Influenza A and B cause seasonal influenza.
- Each year, there approximately 3-5 million cases.
- Influenza spreads when an infected person coughs or sneezes.

Peak Month of Flu Activity 1982-1983 through 2024-2025



Flu season in the United States, CDC,
<https://www.cdc.gov/flu/about/season.html>

Mathematical Modeling of Seasonal Influenza

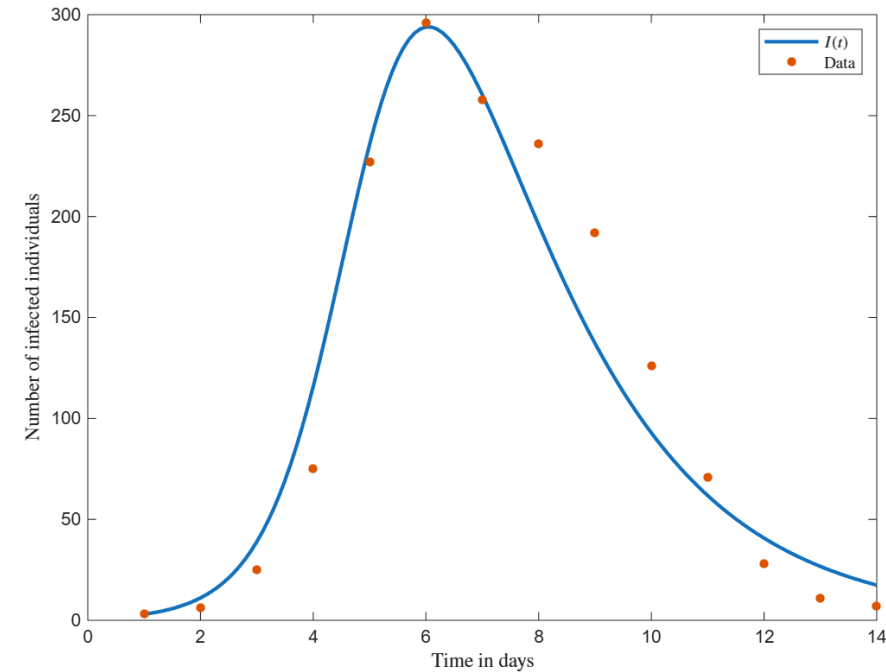


State Variable	Description
$S_{t,i}$	The number of susceptible individuals in patch i at time t .
$E_{t,i}$	The number of exposed individuals in patch i at time t .
$I_{t,i}$	The number of infected individuals in patch i at time t .
$R_{t,i}$	The number of recovered individuals in patch i at time t .
$N_{t,i}$	The total number of individuals in patch i at time t

Parameter	Description
β_i	Transmission rate in patch i .
σ_i	Transition rate from exposed to infected in patch i .
γ_i	Recovery rate in patch i .
μ_i	Natural death rate in patch i .

Implications from the Seasonal Influenza Model

- Establish a threshold for an outbreak.
- Given an outbreak, determine the epidemic duration.
- Simulate control scenarios.
- Insights on which control measures can influence the disease dynamics.
- Forecasting epidemic peaks.



$$\mathcal{R}_0 < 1?$$

Project Goals

- Simulate the dynamics of a seasonal influenza model in a network setting.
- Estimate the adjacency matrix from a mixing matrix (cell phone data).
- Using seasonal influenza data, estimate the parameter values for a seasonal influenza outbreak.
- Examine scenarios in which an outbreak of seasonal influenza can be mitigated.
- Understand what parameters have the most influence on disease transmission.