NME 2021

Network Modeling for Epidemics

# WELCOME!

## NETWORK MODELING FOR EPIDEMICS

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# Objectives for the 1 week course

Gain intuition about epidemic dynamics

- Strengths and limitations of the different modeling frameworks

Understand the principles and methods of network analysis relevant to infectious disease epidemiology

- Descriptive network analysis
- Statistical network analysis with ERGMs and TERGMs
- Empirical study designs for networks

Develop the knowledge and software skills to run your own simple network transmission models.

- Using R and the EpiModel package

Learn how to extend EpiModel code for your own research applications

# The lesson plan for the week

| Day | Content |
|---|---|
| 1 | Epidemic models – overview of the range of methods available<br>• Deterministic vs. Stochastic;<br>• Compartmental vs. Individual vs. Network<br>Introduction to Network Analysis |
| 2 | Statistical models for networks<br>• Exponential Random Graph Models (ERGMs) for static networks<br>• Separable Temporal ERGMs (STERGMs) for dynamic networks |
| 3 | Disease transmission on dynamic networks -- Basics<br>• Closed population, network dynamics are independent of disease dynamics |
| 4 | Disease transmission on dynamic networks -- With feedback<br>• Open population, network and disease dynamics interact |
| 5 | Extending EpiModel<br>• Exploring your research questions |

# Software: based on R

## Core statnet packages

(network, sna, ergm; networkDynamic, tsna , tergm )

static nets — dynamic (temporal) nets

For a broad range of descriptive and statistical network analysis

## statnetWeb

User-friendly GUI to access core statnet functionality for static nets

Days 1-2

## EpiModel

Package to conduct epidemic modeling on dynamic nets

Both GUI and command-line versions

Days 1-5

# Objectives for today

- Develop epidemic modeling intuition
  - Elements of infectious disease transmission systems
  - Signature dynamics of classic systems: the SIR/S family
  - Modeling frameworks, and key differences between them
    - Deterministic compartmental models (DCM)
    - Stochastic individual-based (or “agent-based”) models (IBM/ABM)
    - Stochastic network models
- Explore simple stochastic IBMs
  - using the EpiModel web interface
- Learn basic network concepts and descriptive analysis
  - using statnetWeb

# Group lab

20 MINUTES

# In the group:  First introduce yourselves

- Who are you?

- You've been broken into groups roughly
  - Homogeneous on domain of research interest
  - Heterogeneous on R coding expertise

# Group lab 1: the SIR model

- HW assignment was prep for the course
- Now, a quiz ☺
  - We'll divide you into breakout groups
  - Each group will submit 1 set of answers to the quiz
- Quiz url
  - https://catalyst.uw.edu/webq/survey/morrism/411275
  - Will post in the zoom chat
  - It's anonymous

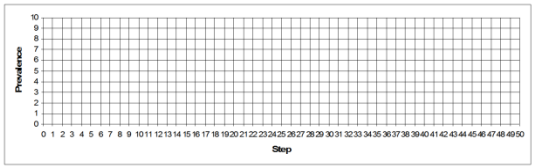
*Starting with intuition:*

# Poker chip simulation

- **Blue chips** = susceptible
- **Red chips** = infected
- White chips = recovered

We will simulate and track the epidemic by hand

*old school, analog style*



# Group Lab 1 Instructions

In your breakout room

- Choose the person to fill out the quiz for the group: **the QT**
  - The QT opens the quiz in their browser
  - The QT will share their screen

- Discuss amongst yourselves how to answer each question
  - The QT will record the group answer online
  - If you have questions, request assistance using the Zoom utility

See you in 20 min!