Epidemiology Modeling for Compliance Graph Analysis

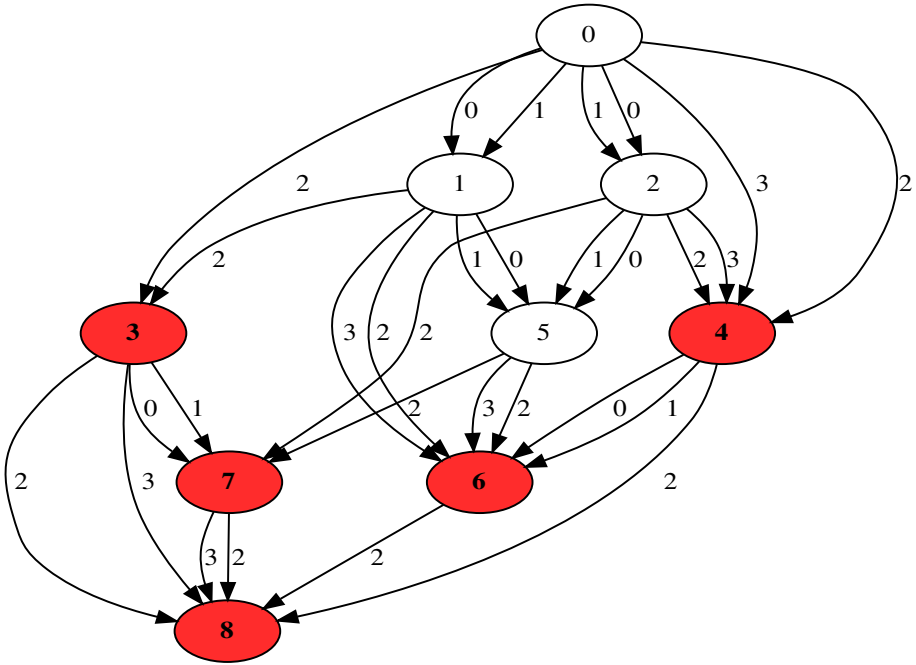
CS-7863: Scientific and Statistical Computing

Final Presentation

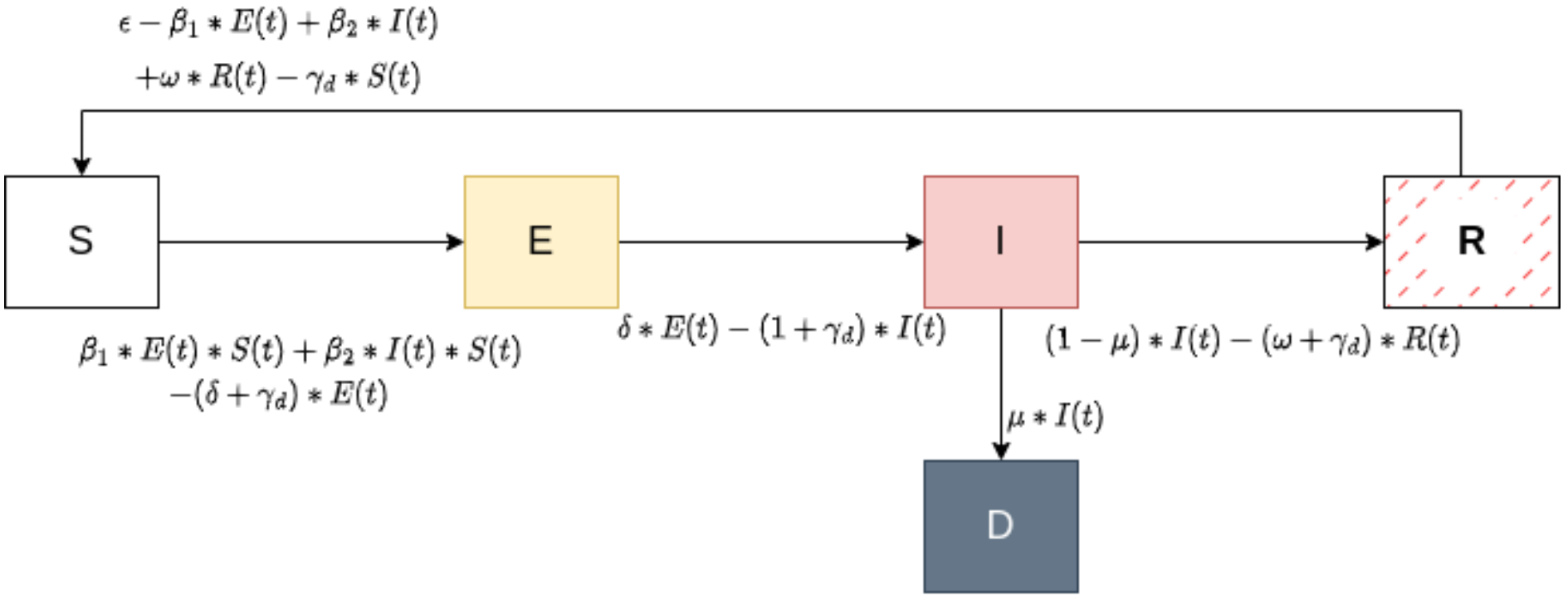
Noah L. Schrick – 1492657

Introduction to Compliance Graphs

- Determine all possible ways systems may fall out of compliance
- Directed Acyclic Graph
  - (DAG)



SEIRDS Epidemiology Model



Model Parameters

$\beta =$ rate of infection

$\delta =$ symptom appearance rate

$\gamma_R =$ recovery rate

$\gamma_D =$ death rate

$\mu =$ fatality ratio

$\epsilon =$ infected import rate

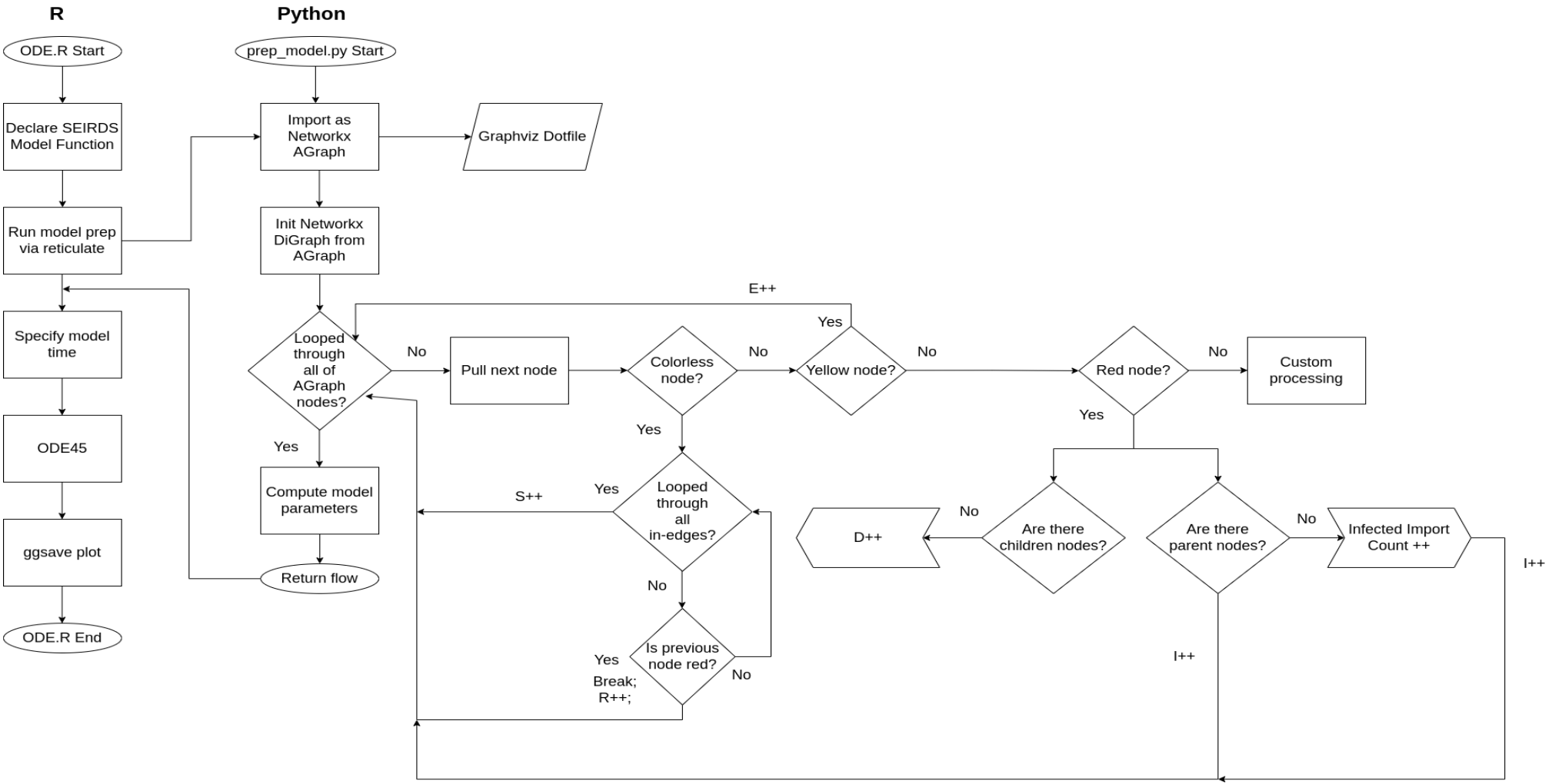
$\omega =$ waning immunity rate

Model Assumptions

- Infection rate from Susceptible contact with Exposed compartment is equal to contact with Infected compartment.

- No increase in population.

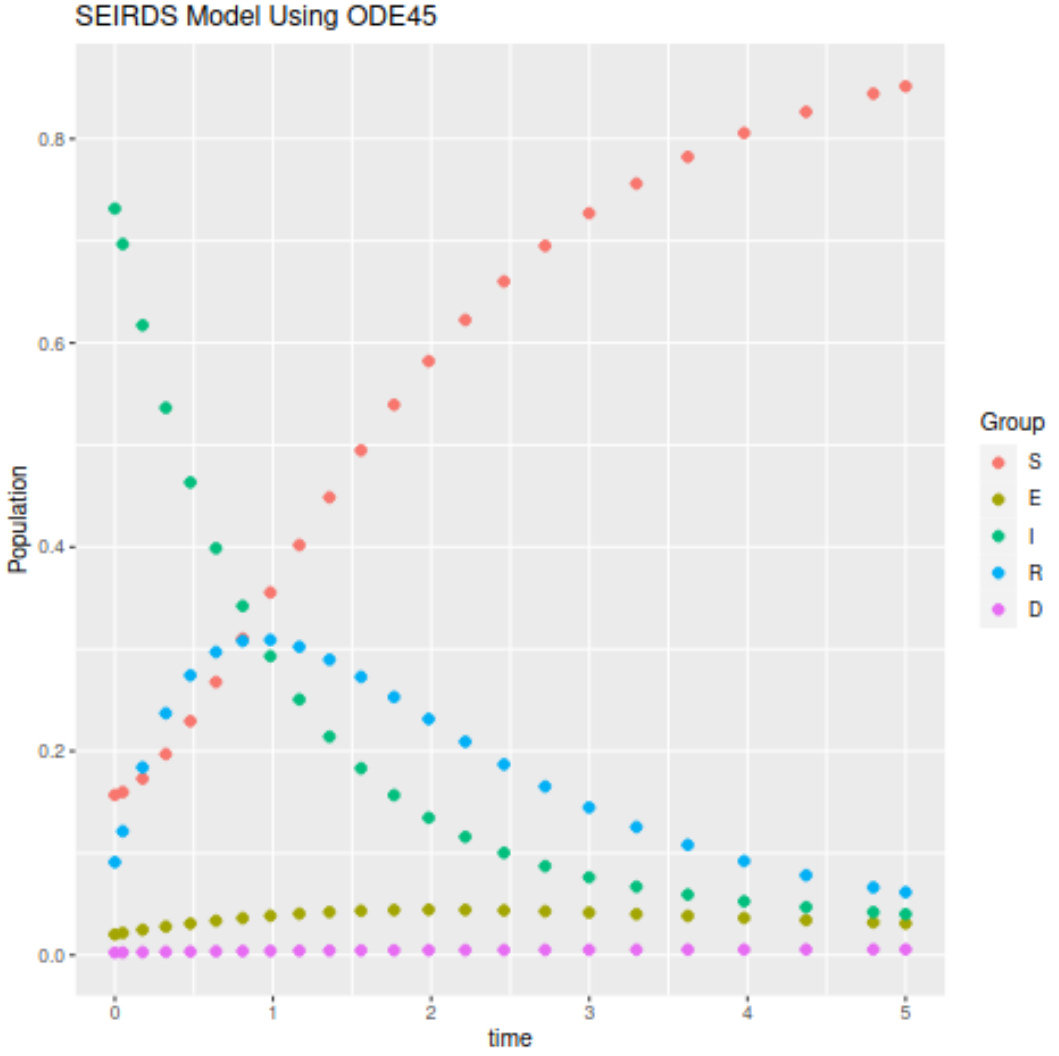
Program Flow



Results (1)

Initial Model Compartments:
S: 62
E: 8
I_R: 288
I_D: 1
R: 36
D: 1

Model Parameters:
beta: 0.4316
delta: 1
gamma_r: 0.0911
gamma_d: 0.0025
mu: 0.0035
epsilon: 0.0
omega: 1



Issues

- Model parameters and compartments are derived from the same network
- Model parameters do not account for the topographical relationships of the network
  - EX: Most ‘recovered’ nodes are upstream. Almost all (~225) ‘infected’ nodes are downstream, and don’t recover.
  - SEIRDS model does not account for this for future time steps

Trivially Weighted Networks

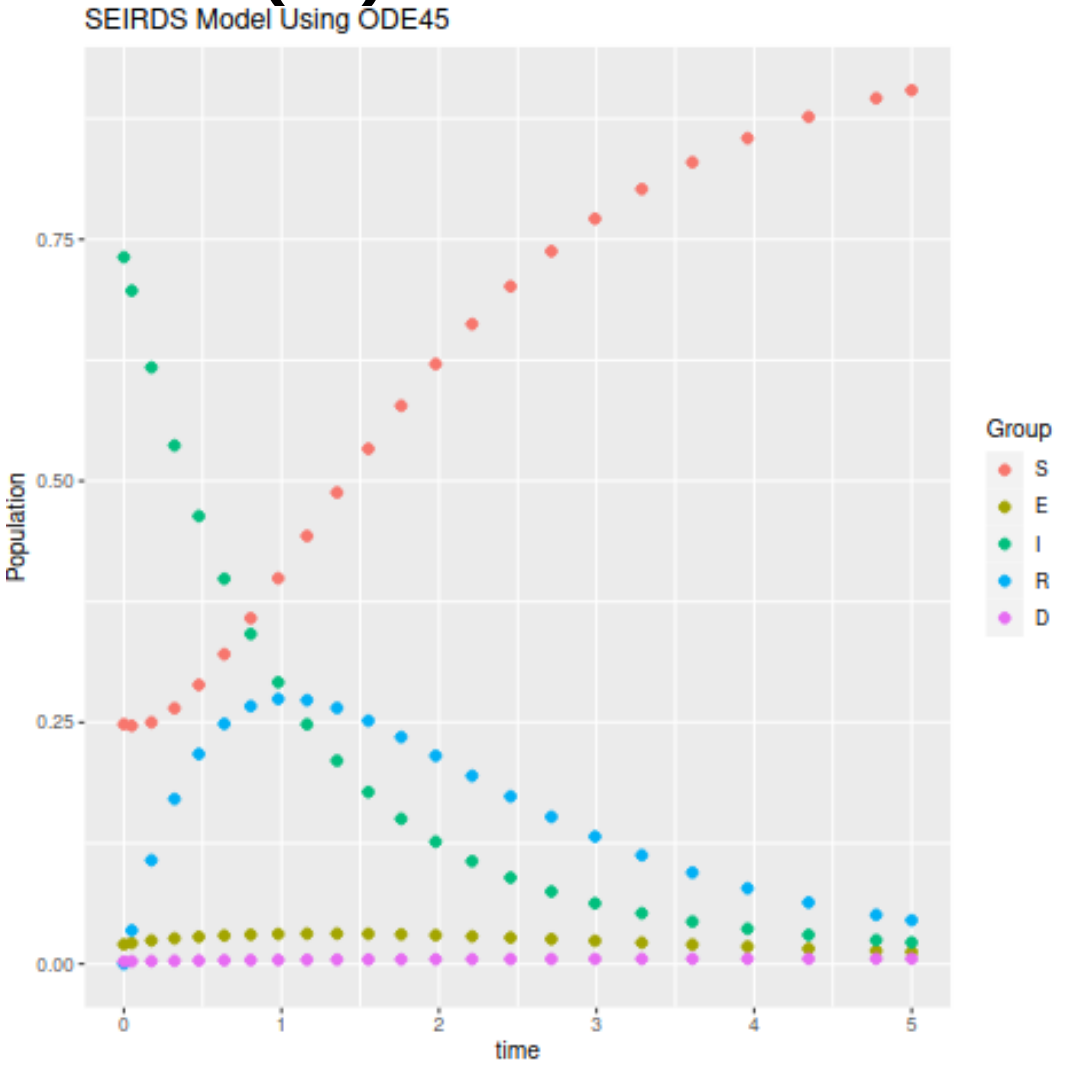
- For each node: $EdgeWeight = \frac{1}{\text{num edges}}$

- Infection rate and recovery rate now take edge weightings into account .

Results (2)

Initial Model Compartments:
S: 62
E: 8
I_R: 288
I_D: 1
R: 36
D: 1

Model Parameters:
beta: 0.2624
delta: 1
gamma_r: 0.0459
gamma_d: 0.0025
mu: 0.0035
epsilon: 0.0
omega: 1



Future Work

- Additional probability parameters for likelihood of recovery
- Multi-strain epidemiology modeling ***(modeling started)***
  - S and R compartments remain the same
  - Split E and I compartments into E_1, E_2, … I_1, I_2 …
- Parameter derivation over time ***(subgraphing started)***
  - Using networks that have time-steps, create subgraphs
  - For each subgraph, compute parameters
  - Compartments based on entire network