SEIRD (deterministic)

vs

SEIRD (stochastic)

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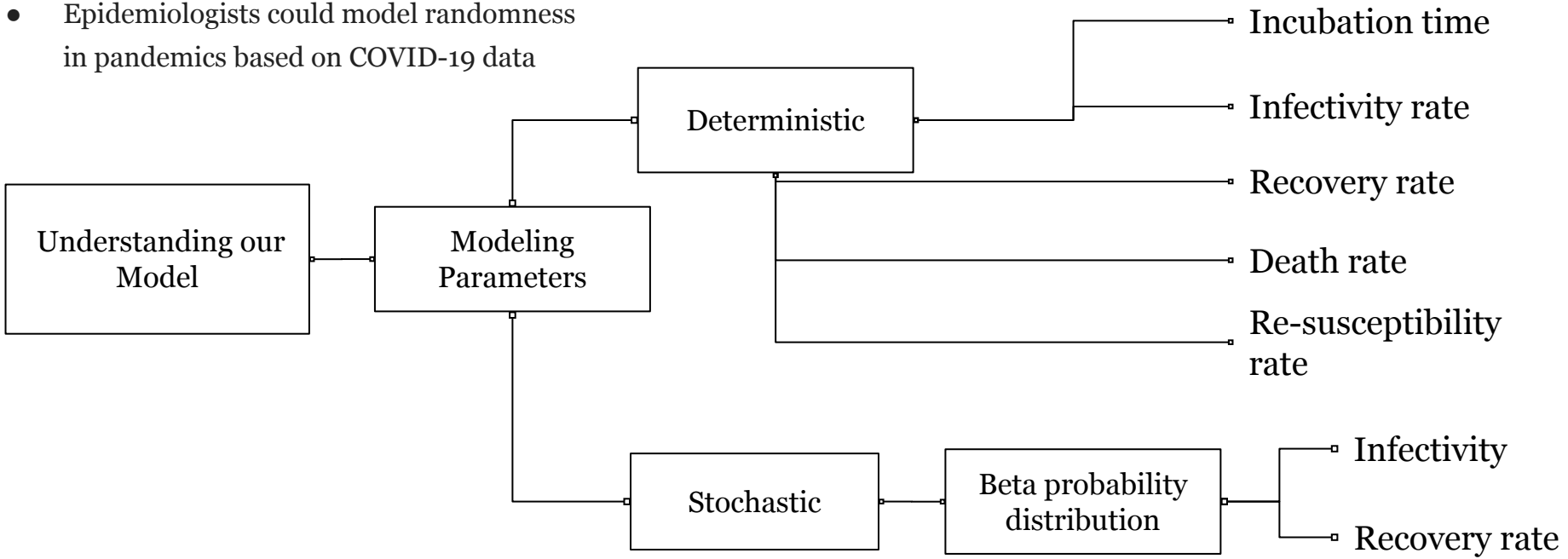
What are the key differences between the SEIRD model with deterministic parameters observed during COVID-19 and the SEIRD model with stochastic parameters, particularly in how they differ in the peak number of infections throughout the simulation?

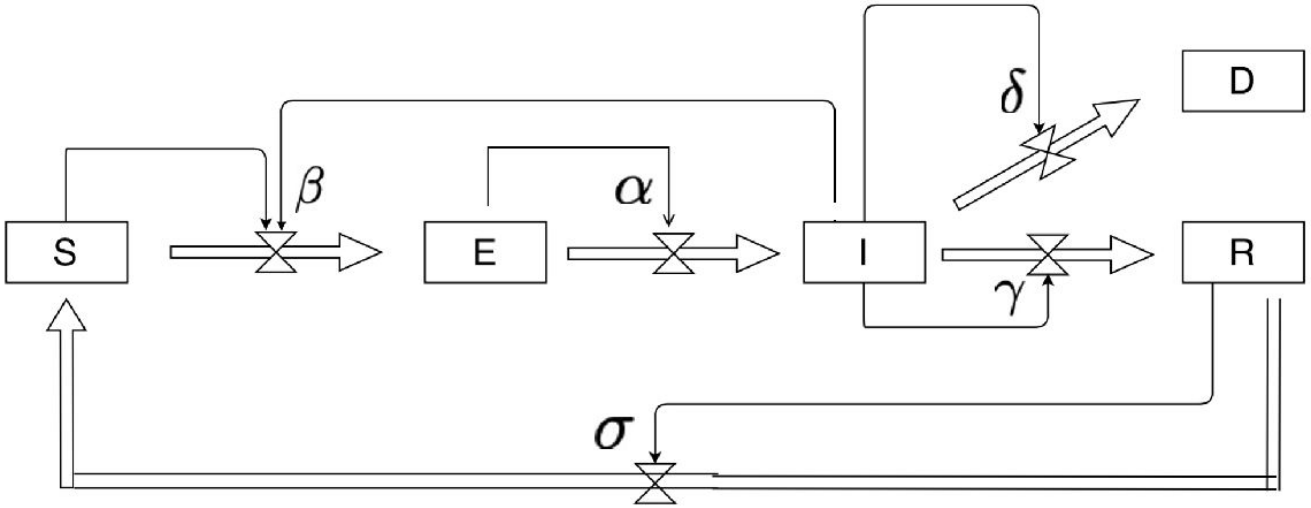
What makes it interesting and important?

- Distinctive patterns of disease transmission in pandemics
- Epidemiologists could model randomness in pandemics based on COVID-19 data

Explanatory Question



SEIRD Model



Stock and flow diagram

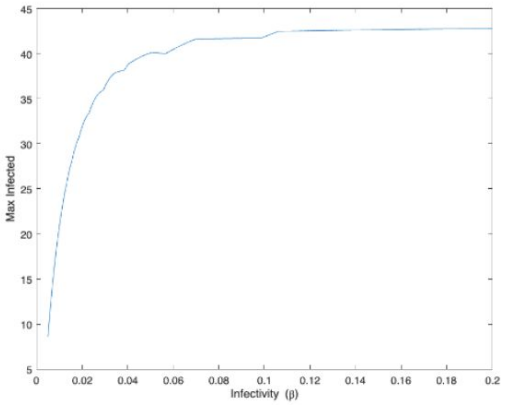
Update state Equations

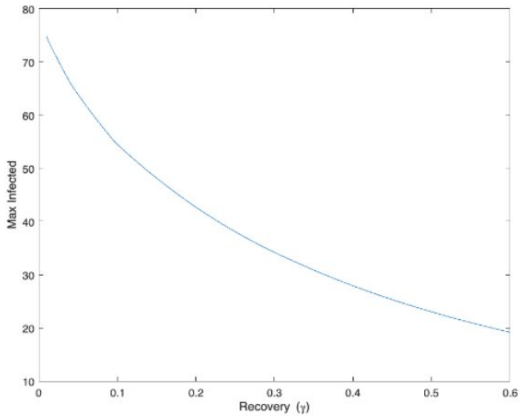
$$S_{n+1} = S_n - \beta IS + \sigma R$$
$$E_{n+1} = E_n - \alpha E + \beta IS$$
$$I_{n+1} = I_n - \gamma I - \delta I + \alpha E$$
$$R_{n+1} = R_n - \sigma R + \gamma I$$
$$D_{n+1} = D_n + \delta I$$

S: Susceptible
E: Exposed
I: Infectious
R: Recovered
D: Dead

α : Incubation time
β : Infectivity
γ : Recovery
δ : Death
σ : Re-susceptibility

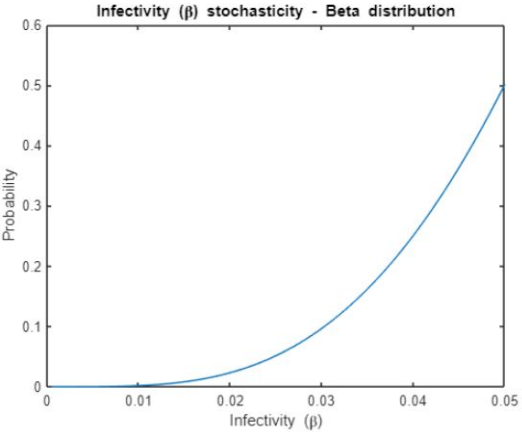
Results

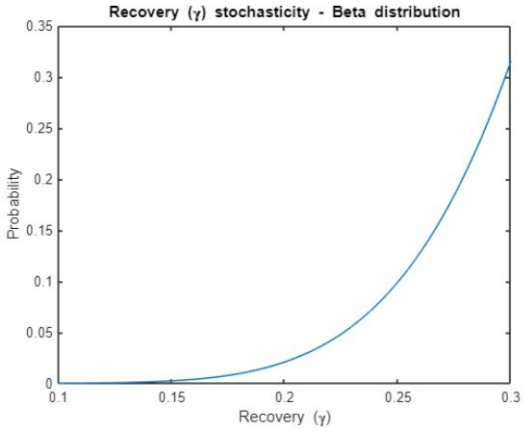


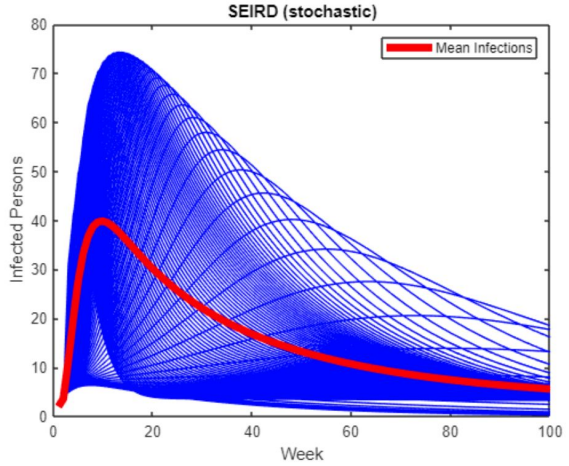


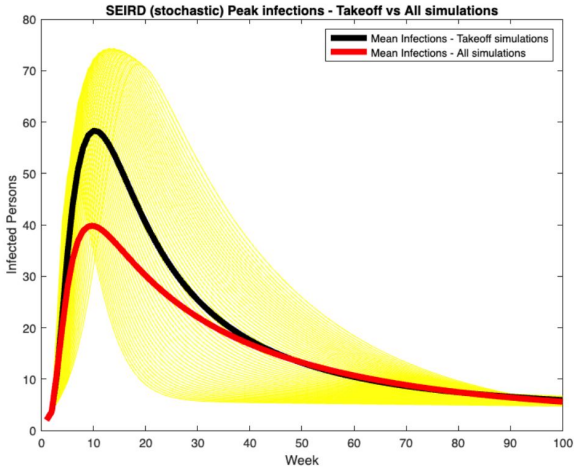
(a) Parameter Sweep for Infectivity Rate β

(b) Parameter Sweep for Recovery Rate γ

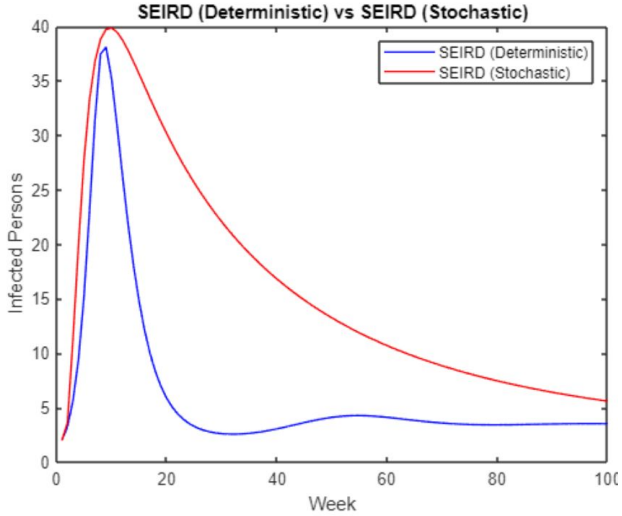


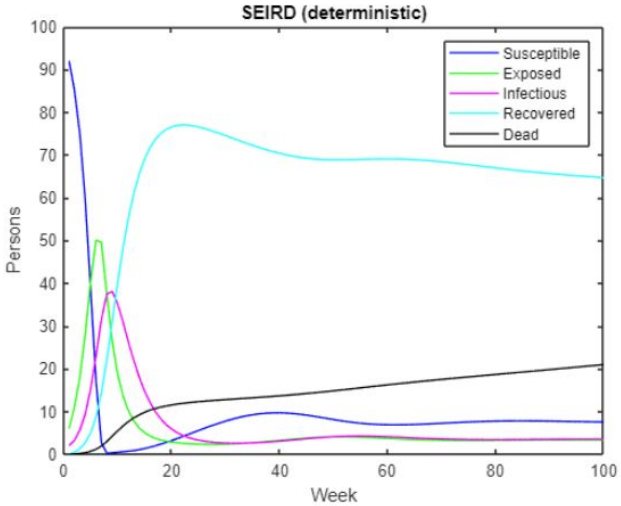


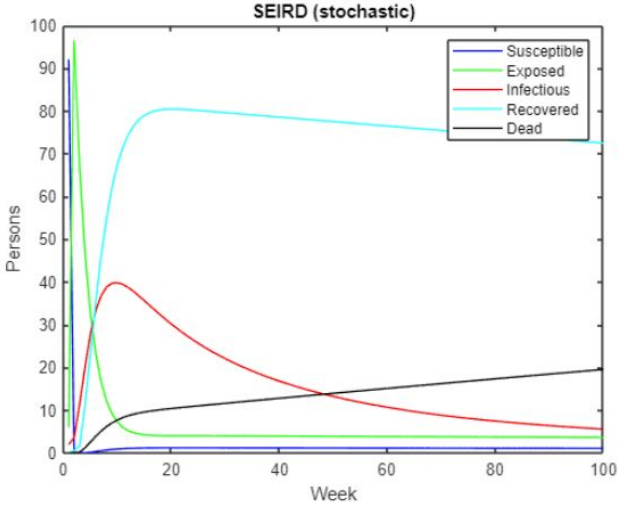




Results - SEIRD (deterministic) vs SEIRD (stochastic)







Interpretation

Results:

- Randomizing infectivity & recovery rate in the stochastic model results in different behavior in the simulation of the maximum number of infections in the model.
- Distinct susceptibility, infection and exposed curves between the two models

Limitations:

- Mean infection curve
- Stochastic Beta distribution (infectivity and recovery)

Future Work:

- Randomizing other parameters
- Testing different cases of “takeoff” simulations
- Simulating both models for longer periods of time