Reaction-diffusion spatial modeling of COVID-19 in Chicago

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Outline

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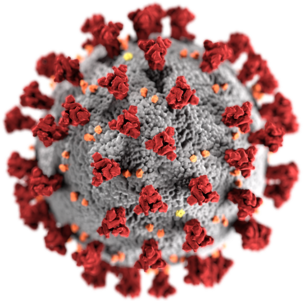
The COVID Problem

Identified in Wuhan, China in December 2019.
Caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

In the United States alone, we currently have

- **37,768,911** total cases
- **626,833** total deaths



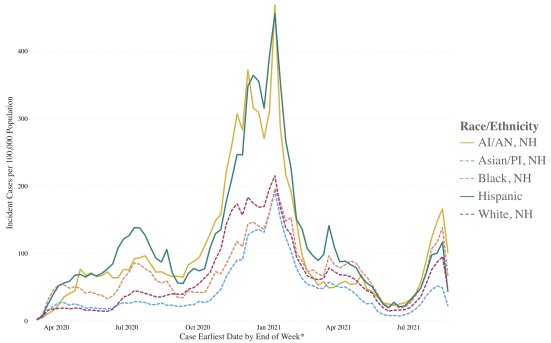
The COVID Problem

Transmission by exposure to infectious respiratory fluids:

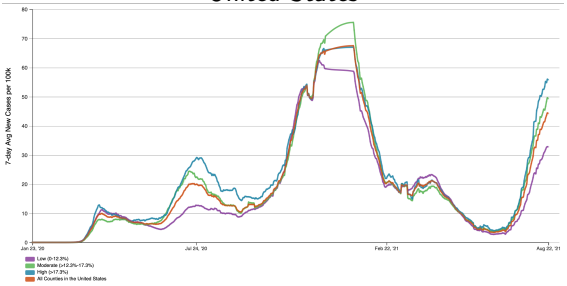
1. Inhalation of virus
2. Deposition of virus on exposed mucus membranes
3. Touching mucous membranes with soiled hands contaminated with virus

The COVID Problem

COVID-19 weekly cases per 100,000 population by race/ethnicity, United States



COVID-19 weekly case rate per 100,000 population by percentage of county population in poverty, United States



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Project Context and Objectives

Models of infectious diseases are usually variations on the **Kermack-McKendrick model** (1927).

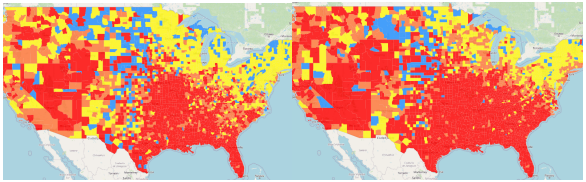
Usual assumptions:

- Population is *homogeneous*
- Transmission is space-independent

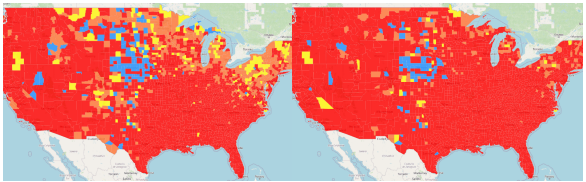
Project Context and Objectives

These assumptions don't match reality!

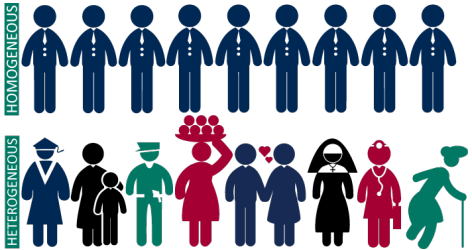
Level of community transmission by county



(a) 7/22/2021 (b) 7/29/2021



(c) 8/8/2021 (d) 8/21/2021



Project Context and Objectives

Idea: Use reaction-diffusion to build explicit spatial dependence.

- The data clearly shows a diffusive pattern
- Spatial dependence can approximate demographic zones

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