

INDIVIDUAL LEVEL AGENT BASED CONTAGION SIMULATOR

Modelling disease spread in the context of rapidly evolving intervention measures and strains

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MOTIVATION

To supplement ODE models of contagion spread with a stochastic network model to capture the inherent heterogeneity of spatio-temporal contact networks; and hence inform Public Health strategy by providing simulations of intervention measures such as masking, social-distancing, lockdowns, household bubbles, vaccinations and testing strategies.



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SYNTHETIC CONTACT NETWORK

Our work is based on the Citisketch™ software package by the Black Arcs, which synthesises data from open GIS and StatCan and to simulate the mobility of a population using the Toronto Area Scheduling Model for Household Agents (TASHA) model. We convert Citisketch™ data into a stochastic contact matrix to simulate disease propagation.

Demography and Labour data



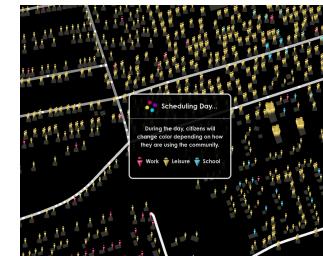
Statistics Canada

Statistique Canada

Building and Land use data



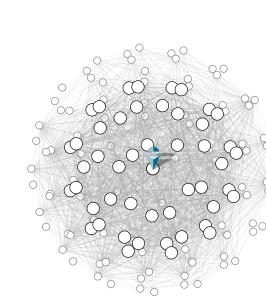
OpenStreetMap®
open data



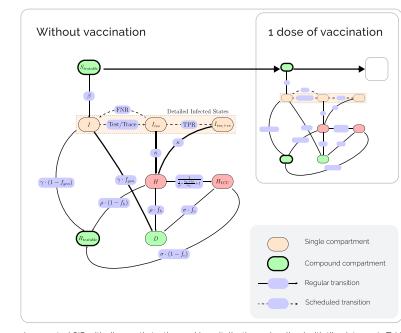
Imagery ©2022 Citisketch™, the Black Arcs

COMPARTMENTAL MODELS

Informed by available data on the SARS-CoV-2 pandemic, we have augmented the SIR model to account for infection latency, asymptomatic vectors, case detection through diagnostic testing, and vaccine-induced immunity.



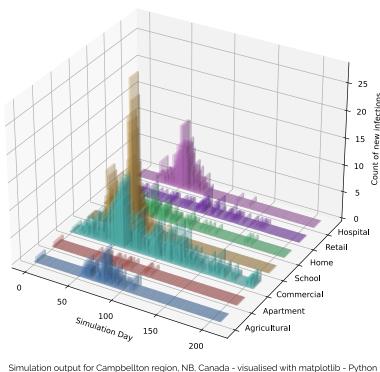
Contact matrix for 200 agents - visualised with iGraph, ggplot2 - R



Augmented SIR with diagnostic testing and hospitalisation - visualised with tikzpicture - LaTeX

SIMULATION RESULTS

Shown here are examples of some outputs from our network simulations. Specifically, these plots show the effects of different contact-tracing and venue-specific lockdown strategies.

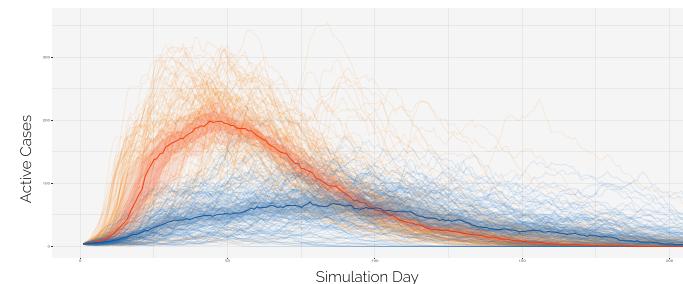


Simulation output for Campbellton region, NB, Canada - visualised with matplotlib - Python

Comparing effect of School Closure on Infections

Control Scenario: — Single run, ■ 20th percentile, □ 80th percentile, — Median

School Closure: — Single run, ■ 20th percentile, □ 80th percentile, — Median



Aggregated Simulation outputs for Campbellton region, NB, Canada - visualised with ggplot2 - R

Comparing effects of diagnostic testing strategy on Infections

Voluntary testing

Total infected

Reported

20th percentile

80th percentile

Median

Delayed Tracing

Total infected

Reported

20th percentile

80th percentile

Median

Same day tracing

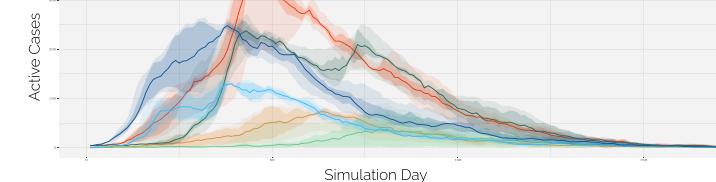
Total infected

Reported

20th percentile

80th percentile

Median



Active Cases

Simulation Day



Link to more example scenarios

Hosted on github.com, <https://github.com/sseahra/>

