Agent-based models of non-pharmaceutical interventions for epidemic control

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7 July 2022

1 Introduction

2 Description of Model

The Current Modifications of the model relate to allowing 10 of the Model Parameters that relate to Compliance to be dynamically updated each day dependent on a given rule these 10 Parameters are.

- TESTING_COMPLIANCE_RATE_SYMPTOMATIC (what proportion of agents take a test immediately as a result of having symptoms)
- TESTING_COMPLIANCE_RATE_TRACED (what proportion of agents take a test immediately as a result of being informed they are a close contact)
- TESTING_COMPLIANCE_RATE_RANDOM (what proportion of agents will do surveillance)
- TRACING_COMPLIANCE_RATE (what proportion of agents comply with contact tracing)
- ISOLATION_COMPLIANCE_RATE_SYMPTOMATIC_INDIVIDUAL (what proportion of agents will isolate given they have a symptomatic case)
- ISOLATION_COMPLIANCE_RATE_SYMPTOMATIC_GROUPMATE (what proportion of agents will isolate given one of their group mates has a symptomatic case)
- ISOLATION_COMPLIANCE_RATE_POSITIVE_INDIVIDUAL (what proportion of agents will isolate given a positive result from a test)
- ISOLATION_COMPLIANCE_RATE_POSITIVE_GROUPMATE (what proportion of agents in a group isolate given one of them has a positive result from a test)

- ISOLATION_COMPLIANCE_RATE_POSITIVE_CONTACT (what proportion of agents isolate given they are a close contact)
- ISOLATION_COMPLIANCE_RATE_POSITIVE_CONTACTGROUPMATE (what proportion of agents in a group isolate given one of them is a close contact)

A simple model might only use a few of these compliance parameters such as

- TESTING_COMPLIANCE_RATE_SYMPTOMATIC = 0.8
- TESTING_COMPLIANCE_RATE_RANDOM = 0.3
- ISOLATION_COMPLIANCE_RATE_POSITIVE_INDIVIDUAL = 0.8

so in this model 80% of agents comply with surveillance testing 30% of agents will take a test if they develop a symptomatic case and 80% of agents will isolate given they have a positive test

The idea of a global state is added to the world based on facts all agents would know one example being the number of agents in the network that have had a positive test within the last 2 weeks (a simplification of "active cases" which we will call it from now on)

The model may incorporate 2 types of agent based characteristics to make these rates non-static, they can be split into global states impacting a parameters value and individual agents situation impacting their compliance An example of global states impacting parameter values following on on from the previous example might be

- TESTING_COMPLIANCE_RATE_SYMPTOMATIC = 0.8 + proportion of active cases
- TESTING_COMPLIANCE_RATE_RANDOM = 0.3 + (proportion of active cases * 5)
- ISOLATION_COMPLIANCE_RATE_POSITIVE_INDIVIDUAL = 0.8 + proportion of active cases

so if at a particular time 7% of the network was an active case then

- TESTING_COMPLIANCE_RATE_SYMPTOMATIC = 0.8 + 0.07 = 0.87
- TESTING_COMPLIANCE_RATE_RANDOM = 0.3 + 0.35 = 0.70
- ISOLATION_COMPLIANCE_RATE_POSITIVE_INDIVIDUAL = 0.8 + 0.07 = 0.87

An example of individual agents situations impacting their compliance may relate to the network itself and an agents close contacts. For example TESTING_COMPLIANCE_RATE_SYMPTOMATIC may be overwritten to follow a

certain rule such as 0.8 OR 1 if the particular agent has at least one close contact in isolation

In the first case we assume agents act mostly based on the global situation and in the latter case they act based on their own individual situation