RAMP Dynamic Model

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Contents

1 Introduction

This document will introduce and explain how the dynamic model works.

2 Stage 1: Individuals deliver risk to locations

In each iteration the synthetic individuals visit some locations (shops, schools, etc.). If they are infected then they impart some of this infection risk on to the location.

Here is one way that we might calculate the 'danger' associated with each location. I've no idea if this is a good way to do it, we need to discuss. Also I suspect that the language used here is not appropriate and will confuse people from disciplines where these words have precise meanings.

The danger, D, associated with a location, l is calculated by summing the individual risks, r, imparted by each agent/individual, a, from a total population of N agents, as they visit the location:

$$D_l = \sum_{a=0}^{N} a_r \tag{1}$$

and where the individual risk is a made up of the proportion of time per day that the individual spends doing that activity, t, and the proportion of visits that the individual makes to that particular location, p[1]:

$$a_r(l) = tp \tag{2}$$

[1]Individuals may visit many different locations, so for each hour they spend doing a particular activity that time is distributed among the possible locations that they might visit.

Also assume that if an infected individual spends 24 hours per day in a location, then they will impart a 'danger' of 1 on to that location.

Is that enough to put some numbers on the 'danger' value? Will obviously need to calibrate the later stages carefully.

3 Stage 2: Individuals receive risks from locations

In the second stage of each iteration, individuals receive some 'exposure' as they visit locations.

Presumably this will vary by the disease status of the individual. Lets assume that the following applies to a susceptible individual, not one who is pre- or a-symptomatic or recovered

The exposure, e, that an individual receives per day, is the summation of the danger, D of all the locations that they visit, L, proportioned by the amount of time they spend there and the proportion of visits to that particular location that they make:

$$a_e = \sum_{l=0}^{L} D_l t_l p_l \tag{3}$$

The final operation in stage 2 is to estimate the new disease status for each individual, based on their current 'exposure'.

4 Worked Example

Not exactly sure there is much value in explaining further, but a small simulation but be instructive..

(Ignore this, I need to include one reference to get bibtex working: [1])

References

[1] Joel Hellewell, Sam Abbott, Amy Gimma, Nikos I Bosse, Christopher I Jarvis, Timothy W Russell, James D Munday, Adam J Kucharski, W John Edmunds, Sebastian Funk, Rosalind M Eggo, Fiona Sun, Stefan Flasche, Billy J Quilty, Nicholas Davies, Yang Liu, Samuel Clifford, Petra Klepac, Mark Jit, Charlie Diamond, Hamish Gibbs, and Kevin van Zandvoort. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *The Lancet Global Health*, 8(4):e488–e496, April 2020.