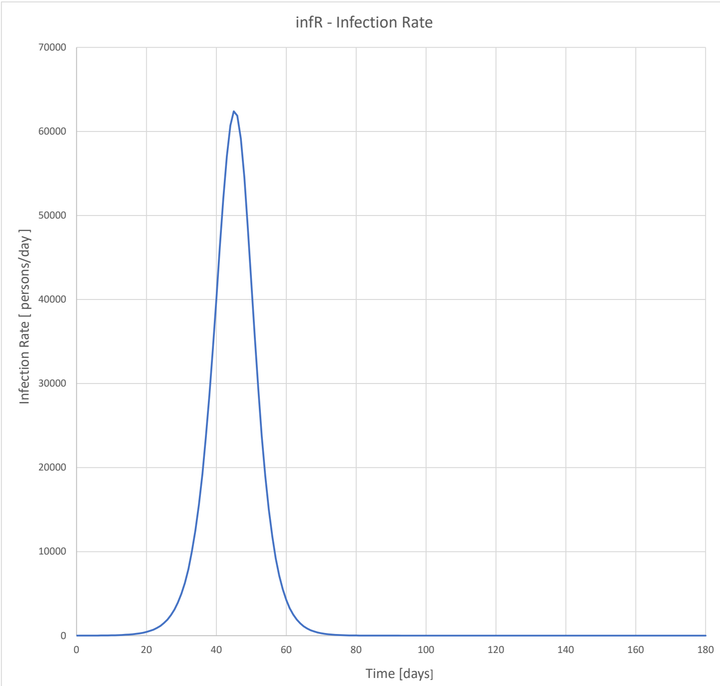
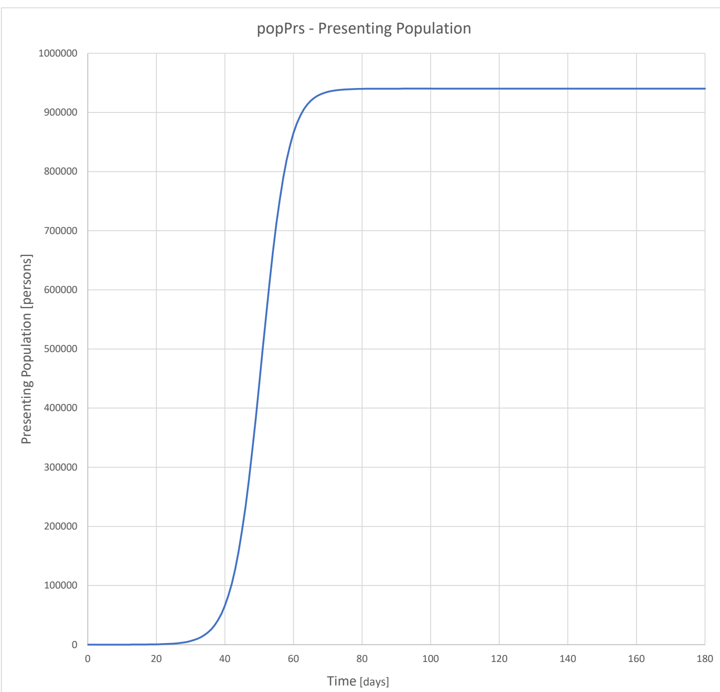
ModelingComplexSystems.net
2020-04-20

Article: COVID-19 Infection Dynamics: How to Know When It Is Safe
Author: Garrett A. Hughes
Analysis Title: Unprotected total population without herd immunity
Output: Run_01
Release Date: 2020-04-18 Updated: 2020-04-20
Model: v1.1.1





Analysis of Output for Run_01

Prerequisites:
1. Open the web page containing the Input/Output Table
   COVID-19 Infection Dynamics: How to Know When It Is Safe
2. Download and open the output text file *Run_01*

Analysis
We ran the model on a fully exposed population of approx. 1,080,000 people. Recall our assumption of this being a fully-mixed population where contact is made at random between individuals. We explain the need for this assumption, and its approximate validity, in the text of the article itself.

Ten of these were incubating and spreading the virus SARS-CoV-2 at random within that population.

The first chart is a time series of the infection rate. At the end of the first week (day 8) the infection rate has risen to 25 [persons/day].

> **NOTE**: values shown in the data runs are for the beginning of that day or the end of the previous day.

At the end of the second week (day 15), the infection rate has risen to 132 per day.

At the end of the third week (day 22) the infection rate has risen to 715 per day. After that it is obvious that the rate of rise, if this were a real population, would be catastrophic.

The infection rate peaks at an unfathomable rate of approximately 62,000 infections per day.

> **NOTE: If** you are new to modeling analysis, you need to be aware that we are aware that results from the model runs are NOT a prediction of what would happen on the ground in a real-world situation. The results do, however, reflect the *potential* impact of the virus on a population of human beings.
>
> In a person's lungs, however, where potentially millions of cells are available for infection, and have no means of escaping, this is probably a very good approximation of what could be taking place. Because of the proximity of lung tissues cells to one another, the maximum infection multiplier - **MAX_InfMu**l - could be much higher than 0.375. This is the reason that a patient could be talking to the staff in the emergency room ,appearing perfectly normal, and near death within an hour.

The data speaks for itself, The infection rate begins to fall after day 45. Recall that the incubating population - **popInc** - that is causing the infection, has its incubation period uniformly distributed between 3 and 9 days.

We think it very important to note that this population has at most only a week or two to react, before the incubating population reaches levels to numerous to suppress. Protection measures must be taken well before the presenting population - **popPrs** - reflects the seriousness of the potential infection rate.

The infection dies out of its own accord because the infection multiplier drops below the value of the equilibrium infection multiplier - **EQL_infMul -** during the course of the epidemic. Note however that that infections do not stop at the value of the equilibrium susceptible population -**EQL_popSus** - because the number of members of the infecting population, popInc, at that point is huge.- roughly 345,000.

It is interesting to note that some 140,000 people escape infection. This is only by sheer chance, as they have taken no protective measures thoughout the epidemic. This represents about 13 percent of the total population.

Of course, in the real world, such as we have seen, protective measures are put in place, but for the most part only after things have gotten out of hand, and thousands have died as a result of not reacting quickly enough.

Our *Policy Analysis* will discuss the implications of these results. Look for a link to appear in the Input/Output Table a short time after the release date of this update.