Procedural Generation Research: Reinfection Dampener

The purpose of the Reinfection Dampener algorithm is to simulate the effect of immunization that can result from getting the same disease more than once. The algorithm works by starting with a base probability, adding a modifier that is summed from both the bonuses and penalties provided by the current context of the disease exposure, then multiplying by the reinfection dampener value.

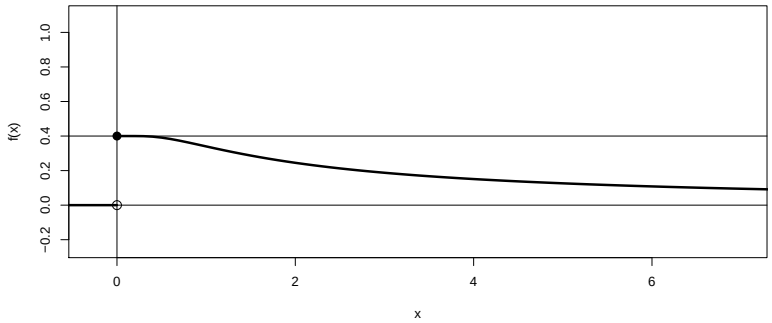
Adjusted to avoid invalid calculations, the formula looks like this:

$$f(x) = (\text{baseProbability} + \text{modifiers}) * (1 - (\text{reinfectionDampener} + 0.00001)^{\frac{1}{x+0.00001}})$$

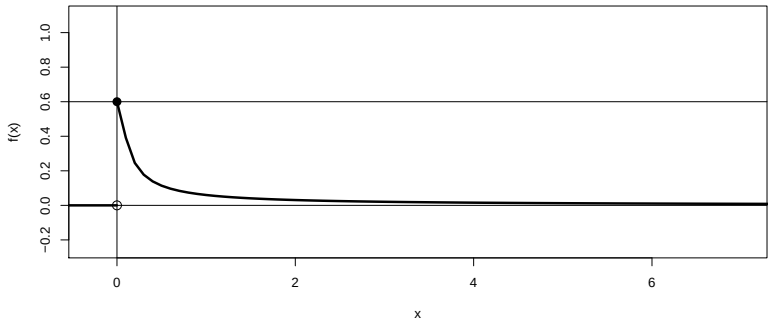
Example case:
If the Flu has a base infection rate of 30%, a 10% increase due to 2 levels of smoking at 0.5% each, and a 15% reduction for each previous occurrence of the Flu, then the first chance of infection would be:

$$f(x) = (0.30 + 0.10) * (1 - (0.15 + 0.00001)^{\frac{1}{0+0.00001}}) = 0.4$$

However, after the first infection, the chance of getting a second infection would drop to 0.3400 and the third to 0.2451 and so on. The graph of this Flu infection behavior would look like this:



By comparison, for a disease like COVID-19 with a very high infection rate and a low reinfection rate we could model it with a base probability of 50%, the same modifier increase of 10%, and a reinfection dampener of 90%. It's graph would look like this:



The chance of infection the first time would be 50.00%. However, the second would be a mere 6.00% and the third would 3.0800% and so on.

Note that this is a simplified approach to effects of immunization due to previous exposure. It does not take into consideration factors such as immunization that diminishes over time or potential immunization benefits from similar diseases.