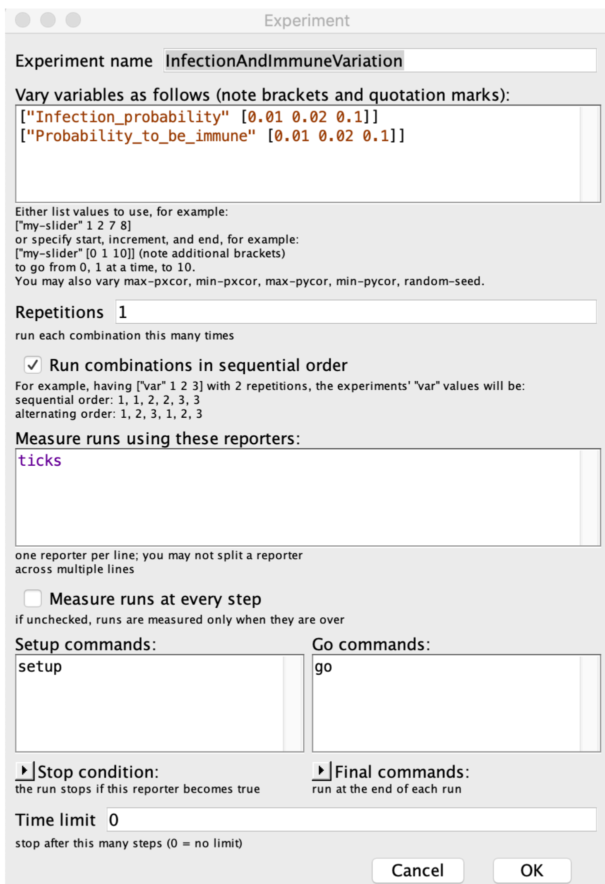
CS108L Computer Science for All
Module 8: Example Milestone 3
BehaviorSpace of an Epidemic Model.

Using the provided epidemic model we want to examine how the probability of infection and the probability to be immune affect the time it takes to become a completely healthy population. So in this case we have 2 different variables we are looking at.

Our BehaviorSpace is setup as follows:



Some things to note with this setup is that there is no stop condition listed. This is because the program has an inherent stop condition we want to use (note the stop condition is when there are no red, so healthy (green) and immune (blue) may exist together. Also, the spread we run through only goes to 0.1 (e.g. 10% chance). We elected to do this for space consideration and because the what we observed is easily shown within this range.

The results:

BehaviorSpace results (NetLogo 6.0.1)																									
epidemic.nlogo																									
InfectionAndImmuneVariation																									
04/28/2019 23:39:14:871 -0600																									
min-pxcor	max-pxcor	min-pycor	max-pycor																						
-16	16	-16	16																						
[run number]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Infection_probability	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.07	0.07	0.07	0.07	0.07	0.09	0.09	0.09	0.09	0.09
Probability_to_be_immune	0.01	0.03	0.05	0.07	0.09	0.01	0.03	0.05	0.07	0.09	0.01	0.03	0.05	0.07	0.09	0.01	0.03	0.05	0.07	0.09	0.01	0.03	0.05	0.07	0.09
[steps]	723	231	364	260	219	1154	344	178	226	229	1365	216	366	168	187	780	297	148	151	131	984	477	157	168	136
[initial & final values]	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks	ticks
	723	231	364	260	219	1154	344	178	226	229	1365	216	366	168	187	780	297	148	151	131	984	477	157	168	136

Ticks represent the time until the community is immune (with this disease model, being cured is equivalent to becoming immune). We can ignore steps, as these are just the ticks and the two probabilities for each run 1-25 are listed above the steps.

The first thing we note is that as immunity increases with a stable infection rate, the number of ticks goes down. This always happens, but it is not really surprising since people are cured faster the time to a healthy population should go down. It does however, give us an indication are model is working as expected.

However, we do note something odd. When looking at the cure chance for our highest setting (0.09) we see the time to a healthy increase initially then drops off at an infection chance of 0.05 and decrease again after that followed by a slight increase (note: this test should be run multiple times to ensure we observe this trend holding, for this example we will assume at least the dramatic drop is true).

We normally would expect an increase in the infection chance would result in more people infected and thus it would take a longer time to cure, which seems to be true from 0.01 -> 0.03. So what is going on here (note: this is something interesting)?

It turns out that that the community rapidly infects the whole community. Each person then moves to the hospital and is almost immediately cured which results in the whole community being cured much quicker than if the disease spread slowly. This might suggest that we want rapidly spreading diseases we have good cures for, but we have to go back to the model and think about that a bit.

The model has a finite population, this isn’t something we generally see in the real world (there are very isolated communities though). Hospital capacity and throughput is not modeled here and we don't know how deadly the disease is. So while we see benefits to the rapidly spreading disease we must caution on the limitations of the model.

Are there other things that you see in the data?