Simple extrapolation of the effect of better NPI e.g. masks, showing power of compounding

It's hard to understand/believe how strong the effect of even slight reductions in R0 are. I previously pointed out that at R0 0.9 NY Pause it takes 11x as long to get the same result as at R0 0.3 as in Wuhan lockdown. This seems like a lot more than it should be, but is simply because 0.9^11=0.31.

I show here that how even slightly R0 decreases from improved NPI can make a **dramatic** difference.

We assume that, as Cuomo suggested a couple days ago, R0 with stay-in-place (eg. NY pause) is 0.9.
We assume as he said that we can afford to be open to a limit of R0 1.2.
We start with a closure because we are at the limit of the number of cases we can handle, say 2500.
We assume we stay closed until we get down to estimated 500 cases.
This is the 5x upper/lower ratio that is shown in the Science paper which there drives rolling waves.
We assume 2 generations per time unit "week".
These numbers are adjustable in the first table.

The base case is the first column with no additional NPI effect 0%. This base case controls for all scenarios (columns) whether we are open or closed. Other columns show what happens if we add masks NPI at different % reduction in R0 while keeping the same open/close regime.

This very crude model shows that even a 5% reduction in R0 via NPI makes a dramatic difference in the outcome. That such would be the case has been observed before as in a paper I circulated weeks ago that pointed out if we could find any vaccine which had even 5% cross-immunity benefit (vaccinating against something else provides even 5% protection against COVID), then that would make a big difference in the trajectory. This because novelty of COVID has otherwise caused us to have no herd immunity. Gradual herd immunity build up reduces the rate of spread over time, but is counteracted somewhat by the fatigue in people complying which has been noted by historians e.g. relative to the 1918 epidemic.

This is a very simple demonstration of the power of NPI, because it improves exponentially. I note that it doesn't assume any herd immunity; at low seropositivity (a few percent) this factor is nowhere near as strong as the R0 reduction, and the delta seropositivity between the different NPI scenarios (different columns) is minimal.

As a final observation, I would also note that if we started at a very high level and have to bring the cases down not 5x as occurs here in weeks 1-9 in the base case but 100x to get to the level that we can contact trace, then this take 2.85 times as long (5^2.85~~100) ie 28 not 9 weeks in the below.

With help from NPI we can greatly reduce the amount of time required to bring the epidemic under control, and to ideally get out of community spread once and for all as is being attempted in NZ.

R0 low	0.9
R0 high	1.2
Cutoff low	500
Cutoff high	2500
Generations/week	2

NPI R0 delta		**0%**	**-5%**	**-10%**	**-20%**	**-30%**	**-40%**	**-50%**
Week 1	Closed	2500	2500	2500	2500.0	2500.0	2500.0	2500.0
Week 2	Closed	2250	2031	1823	1440.0	1102.5	810.0	562.5
Week 3	Closed	2025	1649	1329	829.4	486.2	262.4	126.6
Week 4	Closed	1823	1340	969	477.8	214.4	85.0	28.5
Week 5	Closed	1640	1088	706	275.2	94.6	27.5	6.4
Week 6	Closed	1476	884	515	158.5	41.7	8.9	1.4
Week 7	Closed	1329	718	375	91.3	18.4	2.9	0.3
Week 8	Closed	1196	583	274	52.6	8.1	0.9	0.1
Week 9	Closed	1076	474	199	30.3	3.6	0.3	0.0
Week 10	Closed	969	385	145	17.4	1.6	0.1	0.0
Week 11	Closed	872	312	106	10.0	0.7	0.0	0.0
Week 12	Closed	785	254	77	5.8	0.3	0.0	0.0
Week 13	Closed	706	206	56	3.3	0.1	0.0	0.0
Week 14	Closed	635	167	41	1.9	0.1	0.0	0.0
Week 15	Closed	572	136	30	1.1	0.0	0.0	0.0
Week 16	Closed	515	110	22	0.6	0.0	0.0	0.0
Week 17	Open	463	90	16	0.4	0.0	0.0	0.0
Week 18	Open	556	97	15	0.3	0.0	0.0	0.0
Week 19	Open	667	105	15	0.2	0.0	0.0	0.0
Week 20	Open	801	114	15	0.2	0.0	0.0	0.0