

COVID-19 Modeling for Cornell

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Full modeling report: people.orie.cornell.edu/pfrazier/COVID_19_Modeling_Jun15.pdf

Modeling Caveats

- Results are sensitive to parameters & assumptions
- We don't know what the right parameters are
- Time pressure forced assumptions we would change with more time
(we are continuing to work on these)

Simulation Methodology

- Simulation tracks # of people by:
 - Disease state (susceptible, infectious, symptomatic, recovered / removed)
 - How long they have been in this state
 - Severity of symptoms
 - Whether or not they are in isolation / quarantine
 - Population age distribution is accounted for in transition probabilities
- Simulation also applies these interventions
 - Contact tracing
 - Asymptomatic surveillance
- Notable approximations & things the simulation does not include:
 - Simulation does not include social network structure
 - Accounting for contact tracing & age is approximate

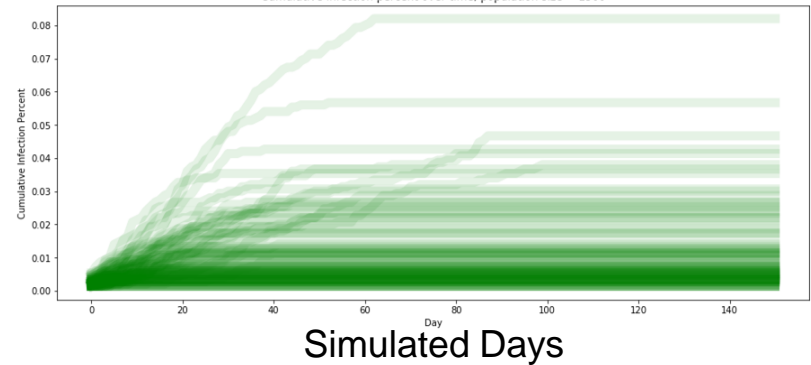
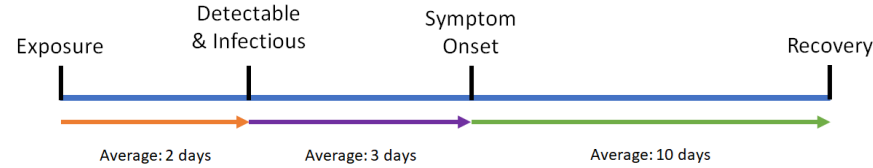


Table 12: Parameters for optimistic, nominal, and pessimistic settings.

Parameter Name	Optimistic	Nominal	Pessimistic
Time in E	Poisson(2)		
Time in D	0		
Time in ID	Poisson(2.5)	Poisson(3)	Poisson(3.5)
Time in Sy (with and w/o symptoms)	Poisson(10)	Poisson(12)	Poisson(14)
Contacts per day (for each free person)	8.3		
P(infection transmission susceptible-infectious contact)	2.6%		
Total population	34310		
Student-origin prevalence	0.5%	2%	4%
Ithaca outside prevalence	0.1%	0.278%	1.25%
Prevalence at beginning of compartmental simulation	0.05%	0.09%	0.175%
Asymptomatic rate	27.3%	47.8%	68.3%
P(self-report each day no symptoms)	0%		
P(self-report each day symptoms)	18%		
New quarantines+isolations per contact trace	7		
(Implied) new isolations per self-report contact trace	0.92		
(Isolations per screening positive) / (isolations per self-report)	0.5		
Fraction of contacts identified and traced	0.5		
Contact tracing delay	1 day	1 day	2 days
Testing false positive rate	0.1%		
Testing false negative rate	10%		
P(an isolated individual recovers each day)	0.05		
P(a quarantined individual is released each day)	0.3		
Age-severity matrix	(Table 5)		
Implied R_0 w/o intervention	2	2.5	3.2
Simulated time length	16 weeks (112 days)		
Parameters for the Excel model	(Table 10)		

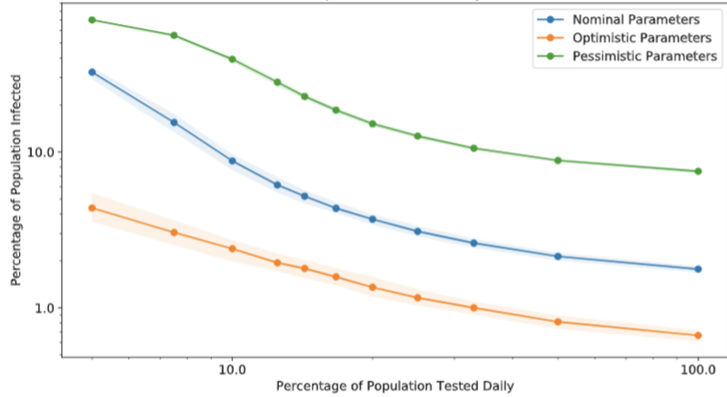
Parameters

Deep thanks for extra support in parameter estimation to:

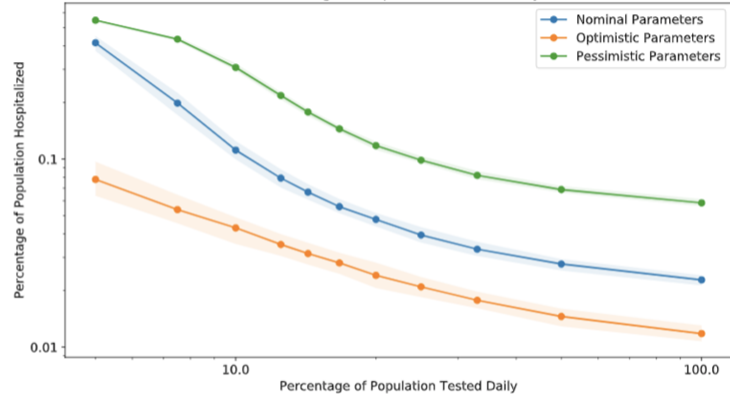
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- President Bob Brown, David Hamer (Boston University)
- Gary Koretsky, Provost Kotlikoff & President Pollack

Example Sensitivity Analyses in the Report

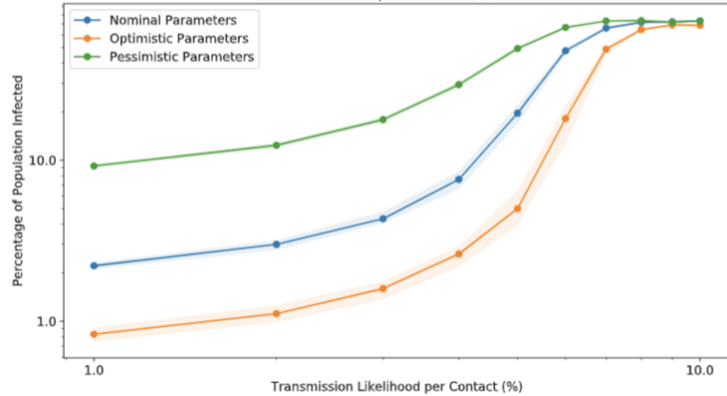
Nominal Parameters: Infection Percentage vs. Percentage of Population Tested Daily



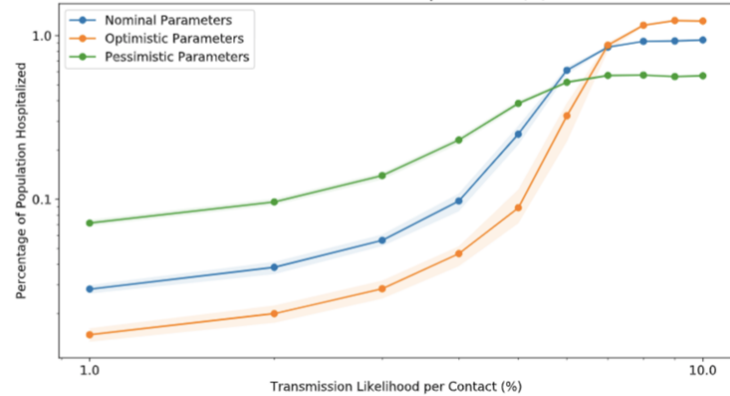
Nominal Parameters: Hospitalization Percentage vs. Percentage of Population Tested Daily



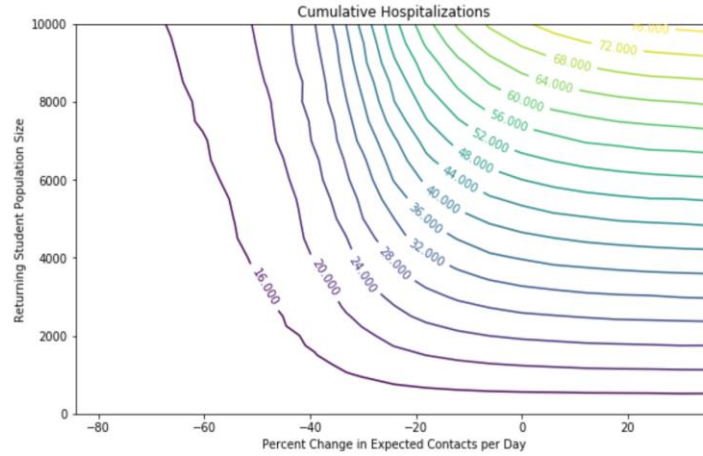
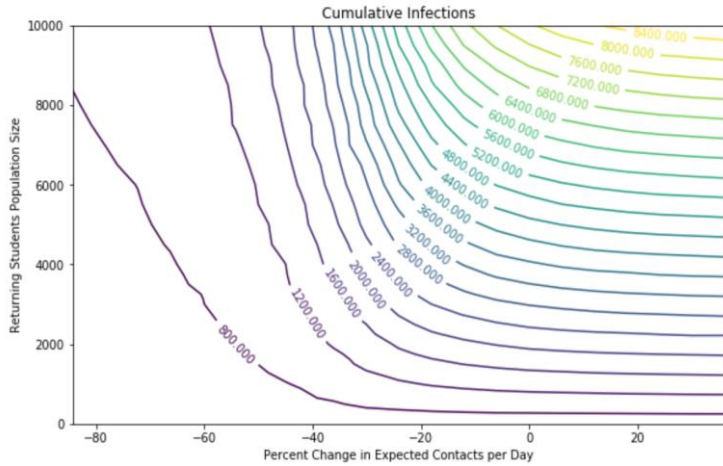
Nominal Parameters: Infection Percentage vs. Transmission Likelihood per Contact (%)



Nominal Parameters: Hospitalization Percentage vs. Transmission Likelihood per Contact (%)

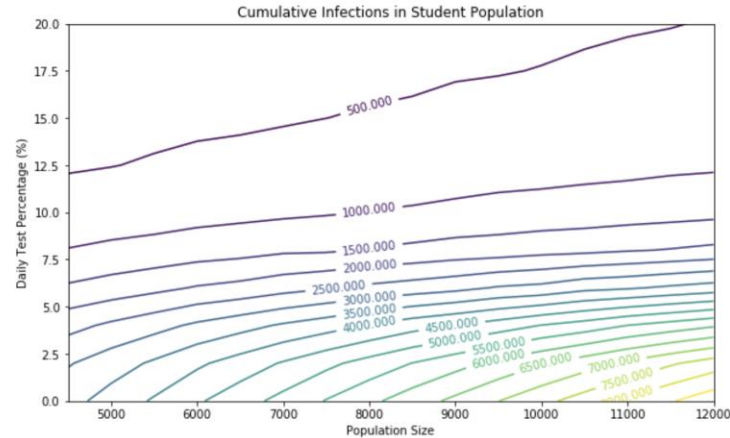
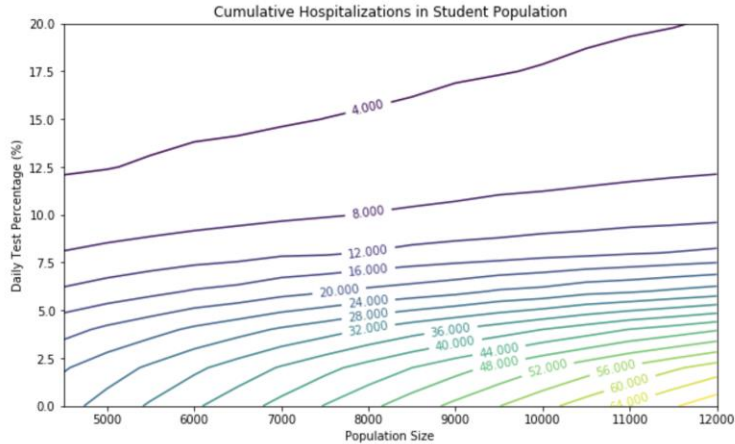


Additional Sensitivity Analyses for Virtual Instruction



Plots show cumulative infections & hospitalizations in the virtual instruction scenario.

Compare to 1250 infections & 16 hospitalizations in the residential scenario.



Summary of Results (Nominal Parameters)

Scenario	Notable Assumptions (16 weeks)	Total Infections During Semester (~50% asymptomatic)	Hospitalizations	Peak Ithaca Quarantine / Isolation of Cornell Population
Full reopen	<ul style="list-style-type: none"> • Contacts / day commensurate with on-campus $R_0=2.5$ absent interventions • Asymptomatic screening every 5 days • Test-on-return using 2 tests • 5 imported cases / day from Tompkins County (1/360 outside prevalence) • 2% prevalence among students before return • The difference between singles-only vs. singles / doubles is captured only by our contacts / day assumption 	1250 (includes 570* infections from community)	16	700 (includes 500 quarantined uninfected individuals. Arise from 9 active infections missed in gateway testing, 22 pre-existing and 5 new infections per day from community)
Online only	9000 students come to Ithaca and live unmonitored	7,200 (includes 335* infections from community)	65*	Unmodeled
Full reopening w/ less frequent screening	7 day asymptomatic test frequency instead of 5 day	1,800 (includes 570* infections from community)	23	720*

* Number does not appear explicitly in the final report, but is computed using the report's methodology

Numbers reported do not include people isolated by gateway testing, all but 20 of which are isolated at their home before coming to Ithaca

Numbers have been rounded from final report