

## MAT 280: Mathematics and COVID-19

Each topic below will be covered briefly for one to two weeks with possible new topics depending on student interest. The material will be largely from papers with those listed here being representative. Students will be expected to choose a project on which to write a report possibly involving computation and then give a class presentation.

### 1. Evolution

- (a) intraspecies: recombination  
Predicting mammalian hosts in which novel coronaviruses can be generated by Maya Wardeh, Matthew Baylis, and Marcus Blagrove.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7887240/>
- (b) intrahost: phylogenies  
Sample size calculation for phylogenetic case linkage by Shirlee Wohl, John Giles and Justin Lessler.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8284614/>
- (c) intracell: quasispecies  
Quasispecies theory in the context of population genetics by Claus Wilke.  
<https://authors.library.caltech.edu/1148/1/WILbmceb05.pdf>

### 2. Population Infection

- (a) SIER differential models  
Mathematical Modeling of Epidemic Diseases; A Case Study of the COVID-19 Coronavirus by Reza Sameni.  
<https://arxiv.org/abs/2003.11371>
- (b) Dynamic Graphs  
Dynamic graph and polynomial chaos based models for contact tracing data analysis and optimal testing prescription by Shashanka Ubaru, Lior Horesh, and Guy Cohen.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8404397/>

### 3. Aerosols

Fluid dynamics of respiratory droplets in the context of COVID-19: Airborne and surfaceborne transmissions by Pallavi Katre, Sayak Banerjee, Saravanan Balusamy and Kirti Chandra Sahu.  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8404377/>

### 4. Tracing

- (a) Zero knowledge  
Privacy-Preserving COVID-19 Contact Tracing App: A Zero-Knowledge Proof Approach by Joseph Liu, Man Ho Au, Tsz Hon Yuen, Cong Zuo, Jiawei Wang, Amin Sakzad, Xiapu Luo, Li Li and Kim-Kwang

Raymond Choo.  
<https://eprint.iacr.org/2020/528.pdf>

- (b) Backward  
Implication of backward contact tracing in the presence of overdispersed transmission in COVID-19 outbreaks by Akira Endo, Quentin J. Leclerc, Gwenan M. Knight, Graham F. Medley, Katherine E. Atkins, Sebastian Funk and Adam Kucharski.  
<https://wellcomeopenresearch.org/articles/5-239/v3>