CS:4980 Computational Epidemiology, Spring 2020
Reading Response 3, Due in class on Thu, Apr 2

Notes: (a) Your submissions will be evaluated for correctness *and* clarity. Correctness is of course crucial, but how clearly you communicate your ideas is also quite important. Organize your thoughts first, write in full sentences, avoid grammatical and spelling errors, and follow standard rules of style for technical writing. (b) Unless you have a documented accommodation, no late submissions are permitted. You will receive no points for your submission if your submission is not turned in at the beginning of class on the due date.

These questions are based on the posted reading "Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand" by Neil M. Ferguson et al. from the Imperial College COVID-19 Response Team. A March 17th article in the Washington Post called this a "chilling scientific paper" and credited it with changing US and UK governmental coronavirus strategies (see "A chilling scientific paper helped upend U.S. and U.K. coronavirus strategies" by William Booth, March 17, *Washington Post*). More recently, Ferguson and his coauthors as well as other epidemic modelers have been accused by some influential pundits as "overselling the coronavirus threat" (see "Coronavirus modelers factor in new public health risk: Accusations their work is a hoax" by William Wan and Aaron Blake, March 27, *Washington Post*).

Some of the main takeaways from this paper that people found "chilling" were: (i) there will be 2.2 million deaths in the US if no interventions are performed, (ii) even with significant interventions, the peak demand for ICU beds will be 8 times the available capacity in Great Britain, and (iii) even with significant interventions now, a similar second wave in the fall is unavoidable. Given your training in this class so far, we would like you to try and critique this paper from a scientific point of view and come to your own conclusions about the results.

1. The model the paper uses is described in Page 4 in the section "Transmission Model." Can you identify some ways in which this contact model might be somewhat unrealistic? Specifically, look for real-world features of contacts that might be missed by the model, but may be relevant to disease-spread predictions.

2. In Table 2, the paper lists 5 non-pharmaceutical interventions (NPIs) that are subsequently evaluated (in Figure 2 and Table 3). Identify any important NPIs that are being currently practiced in the US or elsewhere that do not appear in this table.

3. Elsewhere, I've read claims of the nature that as time passes, societies will get better at performing interventions, possibly due to greater awareness and education. Assuming this is true, how might this be relevant to the Ferguson et al. paper and how might this type of temporal improvement in interventions be included in their models?

4. On Page 8 of the paper, the authors make the following claim:

   > Stopping mass gatherings is predicted to have relatively little impact (results not shown) because the contact-time at such events is relatively small compared to the time spent at home, in schools or workplaces and in other community locations such as bars and restaurants.

   This was surprising to me. I know that stopping mass gatherings (e.g., sports events, tradeshows, concerts, etc.) is a standard social distancing policy. I've also read that one reason for the relatively high case count in New Orleans might be the Mardi Gras celebration from late Feb. Can you provide some further insights into why the authors might have obtained this result? In other words, can you identify any modeling assumptions made by the authors (that might not be true in the real-world) that might have led to this result?

5. The paper is considering an intervention-period of 3 months. For example, Figure 2 shows an intervention period from April 20th to July 20th. One reason that policy makers might balk at the results in this paper is the sheer length of the intervention period that seems to be needed. Based on the experience of Hubei province, does this 3-month period of intervention seem reasonable for the US or the UK? Explain.

6. In Figure 4, the paper considers introducing interventions adaptively, based on a "trigger." They use the number of ICU cases per week as a trigger. Are there alternative and maybe better triggers you could use? For example, a better trigger might catch the upcoming peak a bit earlier.