COVID-19 Version 1.2 Instructions

1. Open Microsoft Excel® or Google Sheets. These instructions were written for Excel 2016. There may be differences in older versions of Excel and in Google Sheets.
2. Open the spreadsheet file provided by your instructor. You should see the following information (note: cells highlighted in yellow represent data that defines a particular scenario; cells highlighted in blue represent model outcomes)
   1. A table in cells A4:C14 that contains symbols, descriptions, and values for some of the quantities that are model inputs. The numbers should be 0.4, 0.024, 0.25, 0.75, 0.1, 0.05, 5, 8, 10, 10, and 100 from top to bottom. The data in cell C3 is provided for reference. See discussion below.
   2. A table in cells E3:I7 that contains an additional set of symbols, descriptions, and values. The numbers in column G should be 1, 0.1, 0, 3.5, and 0% from top to bottom. Cells H3:I7 should be highlighted but contain no data.
   3. A table in cells F9:I13 that contains a list of outcome descriptions and results. The numbers in column G should be 0.3%, 0.36%, 1168, 390, and 5100 from top to bottom. The results in columns H and I contain error messages because data is missing in rows 3:7. This will be fixed later.
   4. Four graphs, showing hospitalizations, new infections, deaths, and percentage at risk, each with one blue curve.
   5. Four additional spreadsheets, called Experiment Data and Scenarios 1, 2, and 3.
3. A more complete description of the data and output quantities appears in document S3-2 Student Notes. These starter instructions focus on just a few cells and graphs.
   1. Cell G12 shows that the model predicts a maximum of 390 patients requiring hospitalizations out of a population of 100,000 in the current scenario.
   2. Cell C3 shows the average number of hospital beds per 100,000 people in the United States. This number is provided for reference. Comparison of this number with the prediction in cell G12 says that this scenario is a public health disaster. On the average, hospital capacity will be exceeded by about 50%, and it will be worse in places that have fewer hospitals or more cases.
   3. The hospitalization graph shows a very steep rise with a peak at about 50 days (48 days, which you can see by looking at the column labeled “H” in the table on the Scenario 1 sheet).
   4. The peak of new infections occurs at day 30. In general, we should expect to see a peak of hospitalizations lag a peak in new infections by about 15 days, which is the sum of the mean incubation time and time from becoming infectious to needing hospitalization.
   5. The total number of deaths in the United States is more than one million. Early estimates were that doing nothing would result in about two million deaths, but we now know that COVID-19 is less lethal than we first thought. The death toll is under 0.4% of the total population, but it is very high compared to the annual deaths from nearly all other causes. Such a high death rate from infectious disease has not occurred since the Spanish flu pandemic of 1918-1919.
   6. Cell C14 indicates that the current scenario assumes there are initially 100 people who have symptoms of COVID-19 in a hypothetical city of 100,000 people; that is, about one in a thousand. This seems like a lot compared to early news reports, but the large reporting of “community spread” meant that many more people actually had the disease than the number identified as having it. Given our estimate of 0.1 for the fraction of symptomatic cases confirmed, 100 known cases correspond to roughly 1000 actual symptomatic cases, along with a lot of asymptomatic cases.
4. What if the scenario starts earlier? Change the number in cell C14 to 10, indicating a much earlier starting point. Notice that the results change immediately.
   1. The calculations are done in a sheet called “Scenario 1” that comes after the top sheet. Information entered into the top sheet gets passed to the calculation sheet, changing the results. The new results are reported immediately back to the top sheet.
   2. How much of a difference did the earlier start make? Very little. The maximum number of hospitalizations and total deaths were essentially unchanged. All that changed was the timing of the peak.
   3. Change the initial number of symptomatics back to 100.
5. It would be hard to learn anything if we could only see one scenario at a time. Instead, the coding has been set up to allow experiments that compare up to three scenarios. The five *parameters* (numbers that are constant in a given scenario but can vary from one scenario to another) in columns E and F can be varied between scenarios. First select the cells G3:G7, then grab the fill handle at the bottom of the selection and drag that handle one column to the right. You should now see the same data and results for scenarios 1 and 2. The graphs are now orange because the curves are superimposed and the last one is on the top.
6. The contact factor (cells G3:H3) is a measure of physical distancing. A value of 1 means that people have a normal contact rate (no physical distancing and no masks). The current scenario is what happens if a community makes no effort to blunt the outbreak of the disease. For comparison, set the contact factor to be 0.5 in scenario 2. This means that people reduce their contact rate to half of its normal value. Note the differences in the hospitalization results:
   1. The maximum is about 60% of what it was with no physical distancing. The new value is slightly less than the average number of hospital beds, but there is not much margin of error. Some communities will have more patients than beds.
   2. Physical distancing delays the peak. This is what the experts mean by “flattening the curve.” Reducing the contact rate can help, but we have to reduce it far enough to make a big difference. Experiment 2 more carefully investigates this question.
   3. The total number of deaths changed only a little. We’ll see in Experiment 2 that more physical distancing is needed to make a big change.