Using Epidemix in Bioinformatics Laboratory (BIOL 112)

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The learning objectives for this assignment are:

- To explore an interactive model of disease transmission.
- To practice documenting your scientific workflow in the service of reproducible research.

Background

- Video: The role of applied math in real-time pandemic response: How basic disease models work
- The SIR Model: Using Math to Save the World: Math Can Predict the Spread of Infectious Diseases
- Giordano, G., Blanchini, F., Bruno, R., Colaneri, P., Di Filippo, A., Di Matteo, A., & Colaneri, M. (2020). Modelling the COVID-19 epidemic and implementation of population-wide interventions in Italy. Nature Medicine, 1-6. DOI: 10.1038/s41591-020-0883-7
- Schnell, S. (2015). Ten Simple Rules for a Computational Biologist's Laboratory Notebook. PLoS Comput Biol, 11(9), e1004385. DOI: 10.1371/journal.pcbi.1004385

Tasks

Refer to Schnell et al. (2015) for rationale and guidelines that professional computational biologists use. You need to describe what you did in enough detail that someone else can reproduce it using only your documentation. You may copy and modify these instructions, making sure to Acknowledge this properly and cite this page in your References section.

1. Watch the video: The role of applied math in real-time pandemic response: How basic disease models work
    - Record two questions that you have after watching the video.

2. Read the information on this website.
    - Look at the graphs and make sure you understand how to interpret them by answering the questions:
        1. What happens if initial I = 0?
        2. What does it mean that red line increases so rapidly?
        3. What does it mean that green line also rises rapidly, but not as rapidly?
        4. What does it mean that the green line reaches nearly to 1,000?

3. You will now explore an online, interactive SIR model, Epidemix.
    - Go to the website and click the "Start" button in the middle of the page.
    - Select the type of model you will explore from the drop-down menu on the upper-left side of the page. Explain why you made that choice.

- Take a screenshot of the initial plot that is shown on the page and display it on your individual journal page (remember, this will be a 2-step process to upload the image file and then display it on your page).
    1. Describe in words what the graph is showing.
4. Now you will explore the model by changing the parameters and seeing what happens to the graph.
    1. Choose one parameter to change at a time. It will be helpful to make "extreme" changes so that you are sure to see a difference. You and your partner can collaborate and make different changes to the parameters and compare your results.
    2. Make the change and display the plot on the Epidemix website.
    3. Take a screenshot of the plot and display it on your individual journal page.
    4. Describe in words what happened to the plot, thus interpreting the effect of the parameter change in the model.
    5. Repeat this process 9 more times so that in the end, you will have 11 total screenshots. The initial conditions and 10 cases where you changed one parameter.

4. Look at Figure 1 of the Giordano et al. (2020) article.
    - How did the authors modify the simple SIR model to take into account features of the COVID-19 pandemic?
    - What public health policy implications does their model have?

5. Check your understanding: https://xkcd.com/2355/. Why is this comic funny? (Hint: hover your mouse over the graphic to see the extra joke in the tooltip.)

6. Write your scientific conclusion: a summary statement of the main result of exercise/research. It should mirror the purpose. Length should be 2-3 sentences, up to a paragraph.

Read

Epstein, J. M. (2008). Why model? Journal of Artificial Societies and Social Simulation, 11(4), 12.

Reflect

1. Based on the reading by Epstein (2008), why should scientists model the COVID-19 pandemic?

2. Why did Dr. Dahlquist give this exercise?

3. Write three questions that you have about the COVID-19 pandemic or the SARS-CoV-2 virus that causes it. These questions can be about any aspect, they do not necessarily have to be about modeling.