## Tutorial for the Dynamic SARS-CoV-2 modeling toolkit for institutes of higher education

**Introduction**

This modeling toolkit provides estimates of surveillance, prediction, and resource capacity for institutes of higher education. Output includes current and predicted number of detected infections, total infections, isolation/quarantine capacity, and baseline surveillance/epidemiological metrics. The modeling framework incorporates statistical models to estimate protection from vaccination and previous infection based on real-time data from Clemson University (updated weekly). Surveillance metrics are derived from current data (see Supplementary Material). Predictions are obtained from compartment-based models (CBM), which utilize results from the statistical models, surveillance metrics, and current literature as input parameters. Additional detail is provided in Supplementary Materials. We have adapted our framework for easy use by other institutions. Users must simply input the relevant size of each subpopulation. Users also have the option to input surveillance metrics and vaccination protection based on Clemson University data, CDC data, or manual entry. We are currently working on incorporate a feature into this modeling toolkit to allow users to upload their own institutional data files for more refined estimation and prediction. Additional features, including surveillance testing cadence, test turn-around time, isolation/quarantine protocols, and disease transmission parameters can be adjusted via the widgets.

By default, this Shiny App uses data from Clemson University, including student (residential and non-residential) and employee (faculty and staff) population size, number of current cases, percent recovered within the last 90 days, and the current isolation/quarantine numbers. All the above have options for users to input their own data. For percent fully vaccinated students (assumed to be young adults of age 18-24) and employees (assumed to be adults of age 25-64) and percent boosted among fully vaccinated, users can use estimates from the Center for Disease Control and Prevention (default), use estimates from Clemson University, or input their own estimates. Details of the prediction and statistical models and input parameters are provided in the Supplementary Material.

In the analyses below, all projected numbers assume the hypothetical situation that the Spring 2022 semester continues.

**Analysis for Clemson University**

If no information is given by the user, by clicking on the “Run Analysis” button, the Shiny App provides a four-week projection for Clemson University under voluntary testing based on data collected from the University up to May 10, 2022. Shown in Figure 1(a) is the projected new symptomatic cases for two affiliation groups (students/employees). Over the four-week projection period, 299 students and 149 employees were detected as symptomatically infected, 1.3% and 2.9% of their respective population sizes.

Alternatively, under “Output by affiliation”, the user can choose to show the projections in four affiliation groups: residential students, non-residential students, faculty, and staff. The four-week prediction of new symptomatic cases is provided in Figure 1(b).

**Analysis for University of Georgia**

We now demonstrate how to use this Shiny App to project infection cases by using data publicly available on the COVID-19 dashboard from the University of Georgia. Detailed input is given in Table 1. To input this information, the user needs to change several default settings on the sidebar.

* Input the “Number of students” and “Number of employees” according to Table 1. Note that if the user has data for the four-affiliation group breakdown of the population, they can choose the “Residential/non-residential/faculty/staff” option under “Input by affiliation”.
* For community population, change the default to the community population size 127,315 of Athens, GA.
* To input the currently infected cases, select “No” under “Use Clemson currently infected”. This enables the input for “Currently infected students” and “Currently infected employees”.
* Click the “Run Analysis” button at the top of the sidebar.

Projections of new symptomatic cases for two and four affiliation groups are shown in Figures 2(a) and (b), respectively.

Table 1. College-specific input parameters.

|  |  |
| --- | --- |
| **Input parameter** | **Value** |
| **University of Georgia** |  |
| …Student population (residential and non-residential) | 40,118 \* |
| …Employee population (faculty and staff) | 10,856 \* |
| …Community population (Athens, GA) | 127,315 † |
| …Percent students vaccinated | 63.5% ▲ |
| …Percent employees vaccinated | 76.2% ▲ |
| …Percent students recovered | 1.8% ▲ |
| …Percent employees recovered | 3.6% ▲ |
| …Current student cases | 24 ■ |
| …Current employee cases | 17 ■ |

\* From [University of Georgia website](https://www.uga.edu/about/facts/).

† From [U.S. Census Bureau](https://www.census.gov/quickfacts/fact/table/athensclarkecountyunifiedgovernmentbalancegeorgia/POP010220).

▲ Estimates from the Center for Disease Control and Prevention.

■ From [University of Georgia COVID-19 dashboard](https://healthcenter.uga.edu/healthtopics/covid-19-health-and-exposure-updates/) as of 5/5/2022. Infection numbers reflect detected infections between 4/25/2022 and 5/1/2022.

A picture containing chart

Description automatically generated

Figure 1(a). Projected symptomatic cases for Clemson University by two affiliation groups.

Graphical user interface

Description automatically generated with medium confidence

Figure 1(b). Projected symptomatic cases for Clemson University by four affiliation groups.

A picture containing chart

Description automatically generated

Figure 2(a). Projected symptomatic cases for University of Georgia by two affiliation groups.

Graphical user interface

Description automatically generated with medium confidence

Figure 2(b). Projected symptomatic cases for University of Georgia by four affiliation groups.