**402 Instructor Notes**

**Continuous Populations:**

Obviously real populations can only be integers. This does not mean that population models must be restricted to integer population values, which would require very sophisticated mathematics. Instead, models generally assume populations are continuous quantities like distance or time. This issue should be addressed, because students will be bothered by a population of 65.24. Remind them that mathematical models are not intended to yield results that are literally correct, but rather to yield results that will help us understand the population dynamics of infectious disease. Models in biology predict “big-picture” results. A value of 65.24 should be interpreted as “somewhere in the 60s.”

**Adapting the Module for Your Students:**

The instructions in file 402-2 are geared to the template file 402-4. These assume that you will want your students to do a lot of the coding themselves. If you prefer, you can pre-code some of the instructions into the template file and then tell your students which of the instructions they have to do themselves. If you want to focus entirely on the simulations, you can give them the completed spreadsheet file 402-5 instead of the template.

**Model Selection and Use:**

When constructing a model on which real-world decisions will be made, the modeler must keep in mind that predictive value depends on simplicity as well as accuracy. This is the correct modern interpretation of Occam’s Razor: it is not that simpler is philosophically better or more likely to be correct, but rather that complexity decreases predictive value. As an extreme example, we can always fit a 5th degree polynomial to exactly reproduce 6 data points, but the resulting graph will have wild swings between increasing and decreasing. Such a model has perfect accuracy for the given data, but no predictive value. Epidemic model parameter values, such as the doubling time and duration of the infectious period, are never known with a high degree of precision. Some are not even well defined; for example, the basic reproductive number is different in areas of high vs low population densities. The basic reproductive number for Covid-19 has been estimated as low as 2 and as high as 8. Given this uncertainty, it is poor modeling practice to try to make a model extremely detailed. That said, the SIR model of this module is clearly insufficiently detailed for Covid-19, and for many other real diseases. Given an infectious period of about 10 days, ignoring the 5-day incubation period is a significant error. The model is also too simple to account for public policy differences, such as isolation of those infectious people who have symptoms.

Given the inevitable uncertainty in the assumptions and data of a disease model, the predictions it makes should not be taken too seriously. Nevertheless, we can make better policy decisions with the use of imperfect models than we can by mere guessing. Informed interpretation of model results can be very important. While specific predictions of how many people will die with a given social policy are only best guesses, predictions that one social policy will lead to fewer deaths than another are much more reliable.