

December 10, 2021

Teaching Modeling with Shiny Apps

Biologists use the Lotka-Volterra equations to explain how two or more species in a system compete for a common resource. While the equations themselves represent a simple model of population dynamics, explaining them to a classroom full of undergraduates is less than straightforward.

"You can show students the equation, talk about the different parameters, and show them a graph based on different parameters, but it's just hard to understand how equations work when you can't see what they actually look like," says **Dr. Lauren Sullivan**.

To help students in her ecology class see this canonical ecological model in action, Sullivan uses a Shiny app that allows students to simulate the dynamics of the Lotka-Volterra competition model in real time.

"Students can change the parameters, like the growth rate of one of the species or the competitive ability of a species and immediately see the effects on the population," she says. "This reactivity – the ability for students to change the parameters and see what happens – is what makes these apps so powerful for teaching."

In addition to the Lotka-Volterra Competition app, Sullivan also uses a Shiny app that models the growth of a stage-structured population and another one that simulates several models of infectious disease spread through populations of interacting individuals.

"In ecology, it's really important to be able to work with mathematical models, and these Shiny

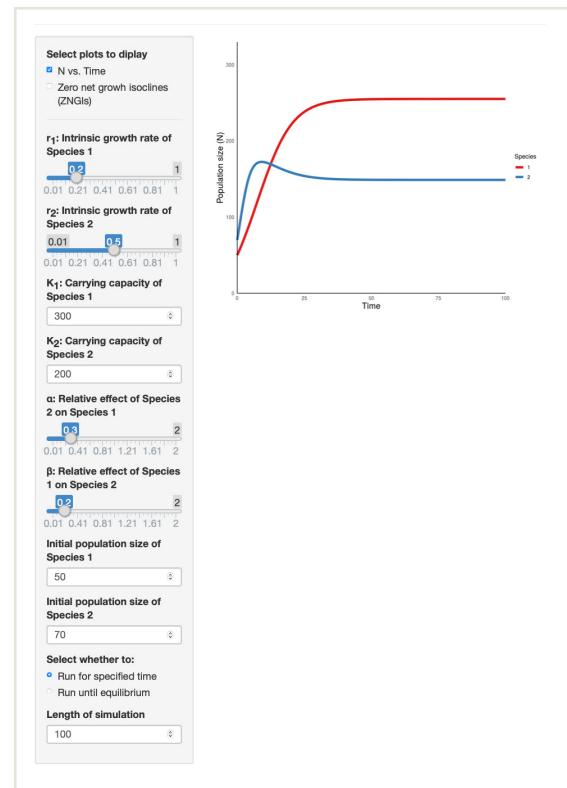
apps are just an easier way to dive more into the math behind these models with students," she says.

All three Shiny apps come from [EcoEvoApps](#), a collection of free, open-source interactive web apps that simulate concepts taught in ecology and evolution courses. The apps were developed by **Dr. Gaurav Kandlikar** together with several of his colleagues from UCLA.

Kandlikar worked with Sullivan last fall to integrate these EcoEvoApps into her ecology class. They also conducted a survey to see if the students were interested in the apps and if they felt like the apps helped improved their confidence in understanding the models. His colleagues carried out similar activities and a similar survey in ecology classes at UCLA.

"Our results generally show that students really like the apps and become more confident in their understanding of the models after these activities, and we're hoping to expand on this research next academic year. The latest "archival" version of the paper is available on [biorxiv.org](#).

Dr. Elizabeth King also finds Shiny apps useful as an interactive activities in her evolution course. Because anyone can develop a Shiny app using R code, many different scientists have developed these apps focused on different fundamental population genetics concepts (see [collated list](#)). For



The interface of the Lotka-Volterra Competition EcoEvo Shiny App

example, King uses [driftR](#), developed by CJ Battey, to teach genetic drift. Like Sullivan, she likes how the apps allow students to interact with data in real time.

"It's a great way to have students get some experience with modeling and see the results of different models without actually having to teach the whole class how to code it themselves, which is usually too big of an ask for an undergraduate class," she says.

These reactive apps are not just useful for the undergraduate classroom. For their Quantitative Methods in Life Sciences course, Sullivan, King, and **Dr. Kevin Middleton** use several [visualizing statistical apps](#) developed at the

Calling All DataPhiles

If bibliophiles flock to libraries or bookstores, where do people with a fondness for data go?

Easy, answers **Dr. Libby King**, DataPhiles.

"DataPhiles is a very friendly, low pressure, helpful forum for anyone to get help on data analysis questions or have a place to go each week to share ideas about different ways to analyze data. It's a place where you can be creative and bounce ideas off other people about ways to approach your dataset," says King, who is one of the co-founders and co-organizers of DataPhiles.

Building community among data scientists is only part of their goal. They also hope to inspire a love for data in others or, at the very least, lessen the anxiety that can often accompany working with data.

"We want to reduce the intimidation and fear that students, particularly early students who are just getting into statistics or programming, often report feeling. We try very hard to make it a place where students can just bring any question and not have that worry," King says.

DataPhiles takes place every Friday at 3:30 pm on Zoom. While when DataPhiles happens does not change, the format can vary. Some weeks, someone will bring their dataset and some questions they have about their data. After a brief presentation, the floor is then open for general question and answer/discussion. On other days, the forum is open to anyone with general questions. They also host workshops occasionally. Recent workshops have focused on using Git and GitHub, on how to make your own R Package, and setting up workflows for the Bioinformatics Core.

If you'd like to be added to the DataPhiles mailing list, email [kingeg@missouri.edu](mailto:kineg@missouri.edu). You can see the schedule for DataPhiles on the [King lab website](#).

Cont. Shiny Apps

University of British Columbia as well as Shiny app that allows students to explore the shapes of different statistical distributions.

"One of the aims in quantitative methods is to help students develop an intuition for data analysis. That includes things like distributions and how the nature of the data impact a statistical analysis. These apps allow students to, nearly in real time, see how changes are reflected in the shape of a distribution," Middleton shares.

[Shiny apps](#) are free to develop and require no knowledge of web development. They are also open-source, so they are free to use, share, and modify. For Kandlikar, this latter feature has several important benefits.

"It just reduces the barrier for anyone who wants to use them. So it's one less thing you have to pay for, from the student's end. But the benefits go beyond that," he says. "The hallmark of these models is that can be adapted to different situations. For example, if you want not two, but three species competing, what happens? With Shiny apps, all the code is available, so if you either know a little bit of R or spend a few days learning, you can change the code to add a third species and see what happens. In fact, our goal is to encourage people to use these apps as a starting point to do whatever they want with it."

Kandlikar is currently working with a few collaborators, including **Sheila Vasquez Morales** from the Sullivan lab, to translate the EcoEvoApps into Spanish and Portuguese to make them more widely accessible.

Around the Division



Speaking of Data

Students from BioSci 3760 (**Dr. Brown's** microbiology lab) and students completing their capstone research presented on the 4th Floor of Tucker Hall this week.



Social Media Highlight

Want to learn about inclusive teaching and collaborate with instructors to enhance your classes? THRIVE Faculty Learning Communities are ready to support you! [Applications for Spring 2022](#) are due Dec 21, 2021.



Adopt-A-Family

Thank you to everyone who donated money to support our two adopt-a-families. We raised enough money to purchase everything both families requested plus meals. We also raised money to provide generous monetary gifts for the DBS custodians. A shout out to **Rebecca Ballew** for organizing the effort.