Instructor Notes

Investigating Determinants of Richness in Ephemeral and Permanent Wetlands Using Linear Models in Shiny[a]

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Adaptation of: Little, A.M. (2018). Environment-richness relationships in ephemeral and permanent wetlands: Guided inquiry with graph interpretation. *Teaching Issues and Experiments in Ecology, 13,* online at http://tiee.esa.org/vol/v13/issues/data_sets/little/abstract.html

This activity seeks to provide a quantitative platform by which students can be taught about interactive effects using the TIEE module created by Little (2018). Key to the adaptation is the use of a Shiny app to create figures and R output for a model that fits an interaction between a determinant of wetland plant and macroinvertebrate richness and wetland permanence. Below I describe the files I have created and how I adapted the Little (2018) activity for an ecology lab for upper division biology majors.

1. Before the lab, I asked students to take a 10 question assessment related to the goals of the activity. This could be used as a pre/post assessment to assess whether the activity improved students' understanding of the key principles. I imported this quiz into our course management system and students took the assessment BEFORE LAB. I asked them not to read any of the information about the lab before coming to lab. This file is *Pre-Post Assessment.doc*

2. Before students arrived in lab, I posted background information for the laboratory. This is mostly identical to the background information in Little (2018), but I did add information for students about positive, negative, and lack of interaction as well as a few other cosmetic details to minimize the number of pages and further explanation on linear models. This file is **STUDENT BACKGROUND_FINAL.pdf**.

3. When students arrived in lab, I introduced the laboratory to them. This mostly follows the layout of the background in (2). Again, however I added information on interaction terms. In addition, I walked the students through the R output they would see in the Shiny App. Because students had minimal training in R and reading output of linear models, this was an important step. Students often misconstrue linear model outputs that deal with categorical variables, and it is important to clearly describe each line and column on the model summary using an example before the students do it themselves. This file is **Intro Lecture.ppt**.

4. After the introductory lecture, I then handed out the class activity. Again this was very similar to the questions provided by Little (2018). However, it does include information for how to use the Shiny app for the purposes of this laboratory exercise. Students worked in pairs on the activity. I asked to students to pause after Part I so I could introduce how to use the Shiny app (see (5) below) in Part II. Specifically, I made sure all students could access the app and then walked through how to use it using the example described in the lecture from (3). At the same time I also showed them how to save images of the graphs created by the Shiny app. The class activity file is **CLASS ACTIVITY_FINAL.pdf**.

5. The Shiny app is currently hosted on my personal Shiny account. It can be accessed at https://kristoforvoss.shinyapps.io/dig_practice/. While the app works well, there are a few glitches that are solely my responsibility. The main glitch is that students must enter the x-axis and y-axis labels they want on the figure. This also affects the R output. That is, even when they choose the correct dropdown menu, the axes and R output labels don't automatically populate. Additionally, the model description at the top of the output corresponds to the R code embedded in the app rather than a readable summary of the model. I plan on fixing these very soon.

6. Students turned in the class activity at the end of the two hour and forty minute laboratory period. A few students needed extra time, and these students turned in the activity the following week. During the following week, I asked to students to complete the pre-post assessment again. Scores generally improved.