QS3: Community Ecology – Simulating the interactions of fundamental processes
Due: start of class on 12/2

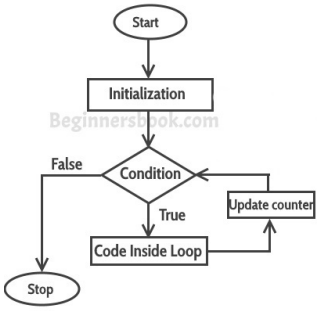
Please work with your group to complete the following questions. Turn in one document containing your responses as a group, including written descriptions and figures. Also submit your accompanying R code. Finally, in addition to submitting the group assignment, please again send me *as individuals* a short (2-5 sentence) description of your contributions to this group assignment. What did you learn and how did you challenge yourself?

Assessment: Based on completion and evidence of effort. I'm looking to see that you challenged yourself and learned something, more than that every answer is perfectly correct. Be inquisitive, be thorough, work as a team.

Simulating the interactions of fundamental processes

Accompanying this assignment, you will find a piece of R code (wrapped in a function) that simulates the dynamics of a pair of species in local communities linked by dispersal, as well as a simple plotting command to visualize the results. This is a zero-sum model based on the mechanics of neutral theory, though for simplicity (and speed) it omits speciation. The model has been embellished with an addition from Mark Vellend that allows you to simulate selection in the communities as well, either constant selection (as you might expect with habitat filtering, for example), as well as frequency dependence. Your job is to use the model to explore how drift, migration, and various forms of selection interact.

1. To better understand how the model works, either:



(a) Read through the code underlying this model, the simulate_metacommunity() function. Do your best to draw a diagram outlining how the model works (e.g., using boxes and arrows to map the steps taken, and labeling/defining key steps or parameters). Use the comments in the code to help you. Highlight which steps were particularly confusing/unclear, **OR**

(b) Create a diagram illustrating an example ecological scenario the model might be used to explore. Illustrate the key features (e.g. patches, species) and include as many processes as possible (e.g., migration, fitness differences, etc.).

2. Using a relatively small local community size (J=100), number of patches (10), and no selection, explore how variation in the strength of migration interacts with ecological drift to shape variation in species composition across communities (patches). In multi-species communities we would typically use a measure of beta diversity, but as we only have two species here, please use the variance in the relative abundance of species 1 at 50 years as your measure of heterogeneity in composition across communities (patches). Produce a plot (or

plots) that demonstrates your findings, and describe the overall interaction that you see between these two processes. Include the R code you used to produce the figure.

3. Explore the interaction of migration and spatially variable but constant selection, such as you might expect with habitat filtering across a landscape. I suggest starting with a relatively small community size for feasibility (J=100, it's OK if there is some drift happening in the background). Specifically, explore what happens when your communities are equally divided between two habitat types, one type that favors species one and another type that favors species two. The fitness advantages conferred by the two habitats should be symmetric (the fitness_ratio_ave values in each habitat should be the inverse of one another), and there should be no frequency dependence. How does increasing migration influence variation in community composition across the landscape? How does diversity within local communities vary with increasing migration? Summarize your understanding of how spatially variable, constant selection and migration interact. If you see evidence of any ecological theories that you know from elsewhere represented in these results, please name them. Include any code needed to replicate your findings.

4. Investigator's choice! Pick a third combination of two or more processes and explore how they interact. Begin by stating your question and describing the simulations you will use to address this. Summarize your findings graphically and interpret them. Include any code needed to replicate your findings.