APHYS 237/BIO251: Quantitative evolutionary dynamics and genomics
Final Project Instructions

Overview and goals: The goal of the final project is to let you practice designing a research project connected to the topics we have covered in the course. The final product will be a written report that will be due at the end of the quarter. You may choose from two main tracks:

Theoretical Track*:* Pick a recent (<20yo) experimental paper from the field. Propose and implement a simulation model that can qualitatively reproduce at least one key finding in the paper, e.g. one of the main figures. *(Note: you should choose something that has not already been modelled in this way in the paper.)* Provide order of magnitude estimates for the input parameters of the model if known, or indicate when they are not known. Choose one limiting parameter regime of the simulation model and solve some aspect of its behavior analytically. Is this a useful limit for describing the experiment or some other natural system. Why or why not? *(If you can't find a suitable parameter regime for this last part, explain why you found it difficult. What potential approximations did you try? Why do they not apply?)*

Experimental Track: Pick a theoretical paper from the field. Propose an experiment to either test one of the predictions of the model, or measure one of the unknown input parameters. Include schematic figures and anticipated figures for what the data will look like. Provide a rough outline of the anticipated materials and personnel budget, in order to demonstrate that the project can be completed in <10yrs and for <$2m. *(Note: the budget part is intended to be qualitative. You don't have to account for every person-month or every set of pipette tips, but I want you to be sure that you aren't proposing $10m in new DNA sequencing, or that you need 50 graduate student years of effort to carry it out.)*

Other options: Since the goal of the project is to get you engaged with the primary research literature, we are willing to consider alternative formats that are similar in spirit to the tracks above. ***Alternative tracks must be approved by the instructor before submission of the preproposal.*** If you think you have an idea for an alternative track, please contact the instructor to discuss potential options.

Preproposal: To help you choose an appropriate topic, each student should submit a 1-2 paragraph preproposal by Feb 25th. In the preproposal, list the general topic you are interested in, the paper you plan to extend, and the track that you aim to follow. For the theoretical track, indicate which experimental finding you want to reproduce with your model. For the experimental track, indicate which theoretical prediction you want to test or which input parameter you want to try to measure, and, if appropriate, what experimental system you would like to employ. **If you have any questions about the preproposal, please contact the instructor.**

Report format: There is no rigid format for the written report, but it should roughly have the format and length of a lab report, a short research article, or a grant proposal. You should introduce the relevant background and results from the paper, and try to explain what you did or what you propose to do at a level that is accessible to other students who have also taken this course. You should include at least one schematic figure and at least one results figure (or hypothetical results figure for the experimental track). Each figure should have a caption clearly explaining what the axes are and what the different lines mean. You should include an abstract and a works cited section with at least 5 references. **If you have any questions about the formatting instructions, please contact the instructor.**

Finding papers: There are several potential strategies for finding a good paper for the final project:

(1) Choose one of the papers referenced in the course notes, and look through some of the papers it cites in its bibliography.

(2) Choose one of the papers referenced in the course notes, and look through some of the papers that cite it. (You can do this relatively easily on google scholar: look up the paper and click the "cited by" link listed below it.)

(3) You can often find good papers by scanning recent table of contents from Nature, Science, PNAS, PLoS Biology, Elife, Nature Eco Evo, Genetics, etc. (Note: papers from physics journals like PRL, PRE, etc. are sometimes ok, particularly if they are cited by other biology papers, but I would not recommend starting from their table of contents.)

(4) You can also find good papers by scanning the recent table of contents for preprint servers like Biorxiv (https://www.biorxiv.org/collection/evolutionary-biology) or arXiv (https://arxiv.org/list/q-bio.PE/recent), though the signal to noise ratio can be a little higher there.

(5) If you have tried some of the options above and feel like you need more concrete suggestions, please contact the instructor.