

SIO 267L Spring 2014

SIO 276L. Quantitative Theory of Populations and Communities Lab. A laboratory complement to SIO 276, to apply quantitative tools to conceptual issues underlying the study of the dynamics and structure of ecological systems.

Syllabus:

In this course we will explore a fundamental research question in theoretical ecology with the aim of producing a novel and publishable piece of work as a team. The larger aim is to teach students how to do team research from A to Z (idea, to mastery of methods, to publication).

An organizing theme in the beginning of the course is to better understand the various conceptual frameworks and methods that are used to understand complex dynamic systems. In particular at the outset we review those classical approaches and methods that are based on a reductionist separable (linear) paradigm based on notions of equilibrium (eg. standard linear stability analysis). We then sketch a framework for the development of new alternative methods that are more suitable for real-world systems that do not fit the separable ideal (where interactions between components are variable, and cannot be treated as constant and independent of each other). In particular we examine empirical approaches based on nonlinear state space reconstruction that address systems that are not separable (whose dynamics are state dependent, aka nonlinear), not in equilibrium, nonstationary, and potentially unstable.

Methods of nonlinear time series analysis are taught in a laboratory setting that involves analysis of model data as well as real observational data. This includes gaining familiarity with simplex projection, S-maps, nonlinear forecasting, state space reconstruction, Taken's Theorem, multivariate and univariate embeddings, tests for nonlinearity, co-prediction, dynamic causation, convergent cross mapping (CCM) etc.

The course involves application and/or development of new quantitative methods to answer a particular question of sufficient scientific merit. The specific topic chosen and how we will approach it is open for discussion and is the first step. Understanding how to formulate a scientifically significant yet feasible project is a particularly important group activity in this team exercise. The course is aimed to teach students how to do research from beginning to end: they gain experience in framing a question, learning quantitative skills for doing the research, organizing the results and are finally given the opportunity to learn what is involved in the publication process (dealing with editors, reviewers etc).

This term, 276L is being offered as a continuation of the course last year that conducted research on understanding forecasting red tides in LaJolla Bay (a century-old institutional mystery). The project analyzed the suite of Scripps Pier

time series (McGowan and his lab met with the 276L team regularly) and was successful in identifying causal variables from a careful nonlinear CCM analysis. This allowed the group to build a family of nonparametric nonlinear mechanistic forecast models that were ultimately tested out of sample and with remarkable accuracy! (Using recent data obtained since the model was made). The focus this term is to review the literature, organize the results, write them up and finalize steps for publication (submit the work, answer reviewer/editorial questions, and see it through to final publication).

Because the time commitment for this term is more finite (will likely not be as extreme), the course is being offered for 2-credits this time only (normally a 4-credit course).