Description
This graduate level course will provide an introduction to modern statistical models used in the analysis of population and community dynamics in ecology. The class will cover some theory but will primarily focus on practical applications including model development and analysis using the programs R and JAGS. The first quarter of the class will review (generalized) linear models and (generalized) linear mixed models and their use in ecology. The remainder of the course will explore more advanced topics including state-space models, mark-recapture models, binomial mixture models for estimating population abundance and demographic rates from count data, single- and multi-species occupancy models for the analysis of species distributions, and integrated population models.

Learning Objectives
1. Comprehend and explain the breadth and scope of current techniques in ecological statistical modeling.
2. Develop and analyze ecological models for the analysis of populations and communities.
3. Demonstrate the ability to communicate quantitative approaches clearly and effectively to an audience of peers.
5. Apply modeling approaches to real data, including data types that are commonly collected during ecological research.

Recommended Background
The prerequisite for this course is IBIO 851 (or equivalent material). The course assumes familiarity with probability distributions and generalized linear models. I will review these topics during the first portion of the course but students with deficiencies in their backgrounds should expect to spend extra time reviewing statistical concepts. This course also assumes familiarity with R; students should be comfortable with command line programming.

Course books
The course will utilize chapters from Kéry (2010), Kéry and Schaub (2012), and Kéry and Royle (2016). Course lectures will be provided but purchasing the books is encouraged for a more in depth discussion of the topics covered in class.

Course website
All class materials will be posted to the course’s D2L website including lab materials and homework. Homework should be submitted via the D2L site.

Grades
Course grades are based on: class participation, lab assignments, and a final project.

Participation (30%): To earn full credit for participation students are required to: serve as a discussant (15%) for an assigned scientific paper, contribute to class discussions, and provide feedback to other students during their preliminary presentations (see below; 15%).

Lab assignments (40%): Most weeks we will be building models using R and/or BUGS/JAGS during class. On some occasions, exercises will be assigned and due in class the following week.

Final projects (30%): The objective of this class is for participants to gain an understanding of appropriate model choice for a given research problem and to gain the necessary skill set to implement such models. To that end, students will conduct a project based on their specific research interests. Ideally, this project should complement ongoing research (i.e., pick something that will help you with your dissertation or at least be an interesting side project!). Grades for the final project will be based on two components: a preliminary presentation (10%) and a final paper (20%). For the preliminary presentation, students should prepare a 10 minute talk outlining the study system and questions as well as some ideas for analysis. The class will discuss the project and provide feedback on potential analyses. For the final paper, students should prepare a ~10 page paper focusing on the analyses they conducted and results of their project. The paper should contain introduction, methods, results, and discussion sections. However, grades will primarily be determined by methods and results sections.
Jan 11  Introductions
Jan 18  Refresher – Model building and analysis
        Kéry (2010) Chapters 1-5
Jan 25  Generalized linear models – Modeling regressions, t-tests, and ANOVAS
        Kéry (2010) Chapters 6-9
Feb  1  Generalized linear models – Linear mixed effects models and more
        Kéry (2010) Chapters 12-14
Feb  8  State-space models – Separating process from sampling error
        Kéry and Schaub (2012) Chapter 5
Feb 15  Capture-recapture models – Estimating abundance in a closed population
        Kéry and Schaub (2012) Chapter 6
Feb 22  Capture-recapture models – Open population dynamics
        Kéry and Schaub (2012) Chapter 7
Mar  1  Binomial mixture models – Estimating abundance from count data
        Kéry and Schaub (2012) Chapter 12
Mar  8  Spring Break
Mar 15  Binomial mixture models – Estimating demographic parameters
        Kéry and Royle (2016) Chapter 6
Mar 22  Occupancy models – Single species distributions
        Kéry and Schaub (2012) Chapter 13
Mar 29  Occupancy models – Extinction and colonization dynamics
        Kéry and Royle (2016) Chapter 10
Apr  5  Multi-species occupancy models
        Kéry and Royle (2016) Chapter 11
Apr 12  Preliminary presentations
Apr 19  Preliminary presentations
Apr 26  Integrated population models
        Kéry and Schaub (2012) Chapter 11
May  3  Final papers due!