

**WILDLIFE POPULATION MODELING (WIS 6466)
SPRING 2012**

Instructor:

Madan K. Oli, Ph.D.
324 Newins-Ziegler Hall
Phone: 846-0561
E-mail: olim@ufl.edu

Office hours:

Tuesday, 1:30-2:30 pm; Wednesday, 10:30am - 12:30 pm.

Lectures:

Location: Newins-Ziegler 354 (WEC Quantitative lab)

Time: Monday, periods 6-7 (12:50 – 2:45 pm)
Tuesday, period 4 (10:40 – 11:30 am)

COURSE DESCRIPTION

Population models are important tools that are routinely used to understand, explain and predict the dynamics and persistence of biological populations. This course is designed to provide rigorous background in the theory of population models, and application of these tools to address basic and applied ecological questions. The primary focus of this course will be the matrix population models because they are powerful, flexible and can be applied to organisms with diverse life-histories and population structures; consequently, matrix models are the most popular models in basic and applied ecology. However, we will also explore topics in life table analysis, integral projection models (IPMs) and individual- (or agent-) based models (IBMs). Relevant concepts in matrix algebra will be reviewed to provide students with necessary mathematical background. Computer exercises will involve analysis of real-life data using MATLAB or other relevant programming languages.

COURSE OBJECTIVES

By the end of the semester, students will:

- Have a thorough understanding of the process of modeling the dynamics and persistence of biological populations;
- Be able to construct and analyze life tables, and age- and stage- structured matrix population models;
- Be able to conduct deterministic and stochastic demographic analysis, including prospective and retrospective perturbation analyses;
- Be able to apply matrix population models to address basic and applied ecological questions using MATLAB or other software platforms; and

- Have a thorough understanding of integral projection models (IPMs) and individual-(or agent-) based models (IBMs), and population viability analysis (PVA).

COURSE MATERIALS

- 1. Lecture outlines and reading materials:** Lecture outlines and other reading materials/discussion papers will be available through the Sakai e-Learning site (<https://elearning2.courses.ufl.edu/portal>). Please note that lecture outlines are not designed to replace lectures. You must be present in the class to take notes. You are responsible for keeping up to date on all announcements and material covered during the class.

To login to the Sakai e-Learning system, go to the e-Learning Support Services homepage <https://elearning2.courses.ufl.edu/portal> and use your GatorLink username and password. You must have an active GatorLink ID to access e-Learning. Should you encounter problems with your GatorLink account or need assistance, contact GatorLink website (<http://gatorlink.ufl.edu>) or UF Computing Help Desk: The Hub, 392-HELP for assistance. If you need assistance with the e-Learning system, please visit e-Learning Support Services home page (<https://elearning2.courses.ufl.edu/portal/help/main>) or contact e-Learning Support Team (learning-support@ufl.edu).

Please use the Sakai e-mail feature for all course-related communications.

- 2. Required textbook:**

Caswell, H. 2001. Matrix population models. Second edition. Sinauer, Sunderland, MA.

- 3. Grading:**

Grading will be based on the following:

Take-home exam	30%
The project (Report: 65%; presentation: 25%; proposal 10%)	40%
Class leadership	20%
Participation	10%
Total	100%

Final course grades will be assigned as follows: >92 = A, 90-92% = A-, 85-90% = B+, 83-85% = B, 80-83% = B-, 75-80% = C+, 73-75% = C, 70-73% = C-, 65-70% = D+, 63-65% = D, 60-63% = D-, and <60% = E.

COURSE OUTLINE

PART I. PRELIMINARIES

2. Introduction to matrix algebra and MATLAB
3. Review of unstructured population models and life table analysis

PART II. AGE-STRUCTURED (LESLIE MATRIX) MODELS

1. Model formulation and parameterization
3. Population growth rate, stable age distribution, reproductive values etc
4. Sensitivity analysis (sensitivities and elasticities)
5. Lower level sensitivities and elasticities
6. Partial life-cycle models (brief overview)

PART III. STAGE-STRUCTURED MODELS

1. Parameterization of stage-structured models
2. Population growth rate, stable stage distribution, reproductive values
3. Sensitivity/elasticity analysis

PART IV. PARAMETER ESTIMATION

1. Estimation of survival and transition probabilities
2. Estimation of reproductive parameters

PART V. ANALYSIS OF LIFE TABLE RESPONSE EXPERIMENTS (LTRE)

1. An overview of LTRE analyses
2. Fixed effect designs
3. Random effect designs

PART VI. STOCHASTIC MODELS

1. Environmental stochasticity
 - a. Formulation of stochastic models
 - b. Stochastic population growth rate and stochastic sensitivities/elasticities
 - c. Environmental stochasticity and probability of extinction
2. Demographic stochasticity
 - a. What is demographic stochasticity?
 - b. Dealing with demographic stochasticity
 - c. Demographic stochasticity and probability of extinction

PART VII. MATRIX METAPOPOPULATION MODELS

1. The Metapopulation concept and its relevance
2. Matrix metapopulation model: construction and analyses

PART VIII. DENSITY-DEPENDENT MODELS

1. Incorporating density-dependence into matrix models
2. Analysis of density-dependent matrix models

PART IX. ANALYSIS OF TRANSIENT DYNAMICS

1. Damping ratio and population momentum
2. Sensitivity analysis of transient dynamics

PART X. INDIVIDUAL-BASED OR AGENT-BASED MODELS (IBMs/ABMs)

1. What are IBMs? Why IBMs?
2. The ODD protocol
3. Implementing IBMs

PART XI. INTEGRAL PROJECTION MODELS (IPMs)

1. Why IPM?
2. Construction and analysis

PART XII. POPULATION VIABILITY ANALYSIS: OVERVIEW

1. Introduction to PVA
2. Sources of uncertainty
3. Estimating extinction parameters: alternative approaches
4. PVA using matrix models

COURSE DETAILS

Take-home exam: Take home exam will require analysis of real demographic data to address important ecological, evolutionary or management questions. Students will have at least two weeks to complete the exam. Completed exams should be submitted via Sakai e-Learning system.

Class leadership: Each student will lead discussion of 2 – 3 papers relevant to the course during the semester. All students will read the lead papers, but the discussion leader will be responsible for summarizing the papers, critically evaluating it and leading the discussion. It may be necessary for the discussion leader to read additional papers, reanalyze the data or propose/demonstrate alternative analytical methods.

The project: The project is an important component of this course, and carries 40% of the course grade. Each student will undertake a population modeling project that addresses important questions regarding the dynamics, regulation, or persistence of biological populations, and will lead to a (hopefully, publishable) manuscript. Here are some relevant details:

- The project must be relevant to this course, and should address questions pertaining to the dynamics, regulation or persistence of biological populations.
- The project typically use 3 types of data:
 - *Simulation studies:* Many important questions in population ecology can be addressed using simulation studies. Because you do not need real data, you can ask questions that cannot be addressed using empirical data. Example: Coggins et al. (2007; Fish and Fisheries 8: 196–210).
 - *Based on published data:* Ideas that make use of published data frequently make excellent projects. Examples, Koon et al. (2006; Ecological Modelling 197: 418–430); Stahl & Oli (2006; Ecological Modeling 198:183-194)
 - *Based on field data:* Of course, you can also use your own data or those of your colleagues'. However, data must be adequate to address interesting and relevant questions.
- Each student must submit 1-page proposal outlining ideas for the project by 5:00 pm, 2 March. I encourage you start thinking about project ideas from the beginning, and not wait until the deadline. I will be happy to meet with you to discuss project ideas.
- The project report should be prepared in *Ecology* (Reports) format (see <http://esapubs.org/esapubs/AuthorInstructions.htm> for guidelines), and submitted via the e-Learning system. The project report is due **April 27, 5:00 pm. The E-learning system will not accept the submission thereafter.**
- The final project report will be graded based on content, quality, relevance and format (*publish as is: A; publish with minor or moderate revision: B-B+; publish with major revision: C+-B...*).

Project presentation: Each student will give a 15-min presentation (plus 5 mins for questions/discussion) summarizing findings of the research project during the last 2 weeks of the

class. The presentations should be of professional quality using PowerPoint or similar technology. Your presentation will be evaluated by me and your peers.

Discussion and participation: Each student will lead discussion of 1-2 papers during the semester. Additionally, students are expected to participate in, and contribute, to all in-class discussions.

Homework assignments: I will assign homework problems for you to work on. Homework problems are NOT graded, and nothing needs to be turned in. It may not be possible for you to work on all of the assigned problems, but I encourage you to complete as many of them as possible. We will also use some of these assignments in lectures or computer labs as examples.

EXAMPLES OF PROJECTS

Some example projects from the past are listed below. Several of these formed dissertation/thesis chapters, and some have been published in peer-reviewed journals.

- Discard mortality affects simulated fishery performances across a range of size restrictions (published)
- Effects of maternal exposure to P,P'-DDE on population growth rates of zebra fish
- Effects of nutrient and water limitation on secondary forest tree populations
- Metapopulation dynamics of the yellow-bellied marmot (published)
- Evaluating single generation fitness measures using a simulation-based approach
- Use of length limits to manage fishery exploitation rates: a simulation study
- Population viability of small, isolated gopher tortoise populations
- Modeling the effects of upper respiratory tract disease on desert tortoise populations
- Exploring the effects of natural disturbances and habitat degradation on the viability of the snail kite populations (published)
- Variation in population growth rates of mottled ducks in Texas and Louisiana
- Demographic analysis of olive-sided flycatchers
- Effects of stochastic disturbance on metapopulation growth rate and patch stage distribution for a long-lived tree species in the Huai Kha Khaeng Wildlife Sanctuary, Thailand
- Walking the Tightrope: the Interplay of Anthropogenic Mortality and Habitat Degradation in Driving the Persistence of Wide-Ranging, Conflict-Prone Species
- The effect of including individual variation in growth on population projections and yield-per-recruit estimates for size-selective fisheries
- Outlining an adaptive management approach for Elephants in the Kruger National Park using matrix models
- Stochastic demography and population growth of a hibernating subalpine rodent (in review)
- Does proximity to roads promote population growth rates of native species? Tests with a Neotropical savanna herbivore

INFORMATION ON MATLAB

We will use MATLAB for all of our computing needs. MATLAB is very flexible and powerful, is easy to learn, and has excellent user interface as well as graphics. Vector-matrix data format used by MATLAB is ideal for implementing matrix population model. All computers in the WEC and CBD computer labs should have MATLAB. Students enrolled in this class should have access to MATLAB. Please contact Tom Barnash (barnast@ufl.edu; 846-0560) for license information. You may also purchase a student or full version of MATLAB at the UF bookstore or MATLAB directly (www.mathworks.com), or purchase a personal license through UF's software licensing services (<http://www.software.ufl.edu/>). For temporary use (1 month), you can download the trial version of the software from www.mathworks.com.

If you are new to MATLAB, you may find the following material helpful:

1. Getting started with MATLAB:
http://www.mathworks.com/access/helpdesk/help/pdf_doc/matlab/getstart.pdf
4. Dr. David Wilson's MATLAB tutorial: <http://www.math.ufl.edu/help/matlab-tutorial/>
5. University of Dundee's MATLAB tutorial: <http://www.maths.dundee.ac.uk/~ftp/reports/MatlabNotes.pdf>
6. Stanford University tutorial:
http://www.stanford.edu/~wfsharpe/mia/mat/mia_mat3.htm

FOR R USERS

You can use R instead of MATLAB for this course, but I will not be able to help you with R programming. R and associated packages can be downloaded from: <http://cran.r-project.org/>. Particularly useful R packages for matrix population modeling include: *popbio* (<http://bm2.genes.nig.ac.jp/RGM2/pkg.php?p=popbio>) and *deomogR* (<http://www.jstatsoft.org/v22/i10>).

Additional information on MATLAB and R will be provided in the class.

CRITICAL DATES

First day of class:	9 January
Martin Luther King Jr. Day:	16 January (no class)
Project proposal due:	2 March, 5:00 pm
Spring break:	3-10 March 3-10 (no class)
Last day of class:	25 April
Project report due:	27 April, 5:00 pm
Reading days:	26-27 April

GENERAL NOTICE TO STUDENTS

Academic Honesty

As a result of completing the registration form at the University of Florida, every student has signed the following statement: “I understand that the University of Florida expects its students to be honest in all their academic work. I agree to this commitment to academic honesty and understand that my failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University.”

UF Counseling Services

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university’s counseling resources. Both the Counseling Center and Student Mental Health Services provide confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance. These resources include:

- University Counseling Center, 301 Peabody Hall, 392-1575, personal and career counseling;
- Student Mental Health, Student Health Care Center, 392-1171, personal counseling;
- Sexual Assault Recovery Services (SARS), Student Health Care Center, 392-1161, sexual counseling;
- Career Resources Center, Reitz Union, 392-1601, career development assistance and counseling.

Technology requirements

Access to and on-going use of a computer is required for all students to successfully complete their UF degree programs. Competency in the basic use of a computer is expected for students in this course. The complete official UF policy on the student computer requirement is found at:

<http://training.helpdesk.ufl.edu/computing.shtml>.

Software Use

All faculty, staff and students of the University are required to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

Classroom Accommodation

If you require specific accommodations to complete this course, please contact the UF Disability Resource Center (located at Room 0001 Reid Hall) by phone: (325) 392-8565 or online at:

www.dso.ufl.edu/drc/.