

NRM 5409

Population Dynamics

Graduate Level

Instructor: Justin French

Fall 2021

RAS 126

2:00 PM - 2:50 PM, Monday, Wednesday, and Friday

Email (preferred): justin.french@sulross.edu

Phone: (432) 837-8505

Office Hours: Fridays, 1:00 PM to 4:00 PM, or by appointment.

1 Course Overview

This course is intended to give the student a thorough introduction to the theory and modeling of population dynamics. We start with first principles, and quickly generalize into more detailed (and useful) views of how populations change. Population dynamics are the scientific backbone of wildlife management, so this course is designed to give you both an academic and practical understanding of the field. This course will challenge you to reckon with the complexity of real-world populations and how to make defensible management recommendations in light of it.

Each week we will spend a lecture on relevant theory and a lab that applies it, then we will spend a day examining applications in more detail, then we will have a day reviewing and discussing the implications of what you've learned. By the end of the class you should be able to:

1. Frame management problems in terms of population outcomes
2. Select relevant theory/models to use in addressing management questions or problems
3. Estimate population parameters with real data
4. Interpret model outcomes to make sound scientific inference
5. Use your knowledge to make sound management decisions

2 Required Text

Vandermeer, J. H. and D. E. Goldberg. 2013. Population Ecology: First Principles. Second Edition. Princeton University Press. Princeton, New Jersey USA.

Available electronically at: <https://muse.jhu.edu/book/41676>

I like this book for a couple of reasons. The authors build the concepts and equations incrementally and thoroughly. This book covers topics beyond what we will touch on in class, but by starting with first principles you will have the tools to learn those things on your own when you need them. The material in the book can be a little dense sometimes, but those that dive deep will be rewarded on exam day.

3 Assignments

All assignments in this class will be done in R, integrated with L^AT_EX. R is the most rapidly growing tool in our field and will soon be an essential skill, much like GIS has become. It is best that you install both R and R Studio, which is a convenient interface. They are available for free download at:

- **R:** <https://cloud.r-project.org/>
- **R Studio:** <https://rstudio.com/products/rstudio/download/>

Appropriate L^AT_EX distributions depend on your operating system. Windows users should consider MikTeX, TeXLive, or TinyTeX. Mac users may be better served with MacTeX. All are easy to find with a quick Google search. There are nuances to using each, which I am glad to assist with.

Each regular assignment will be made available on Monday of the week it is assigned and will be due the following Monday. Late submissions will not be accepted unless prior arrangements are made (implying there was a good, foreseen reason to be late), except under reasonable extenuating circumstances.

4 Grading Policy

Grades are based on weekly assignments, 2 exams, and a semester project. Assignments will contribute 33% of your grade, while exams and the final project contribute 33 and 34%, respectively.

Letter grades follow: $100 > A \geq 90 > B \geq 80 > C \geq 70 > D \geq 60 > F$. There is no curve.

5 Attendance

Showing up is the only way to get the material you need. If you don't come to class, your grade will reflect it with no penalty needed from me. In the event of an excused absence, make arrangements with me to go over material ahead of time.

6 Academic Dishonesty

Academic dishonesty includes copying, sharing, or obtaining information from an unauthorized source, attempting to take credit for the intellectual work of another person, falsifying information, and giving or receiving information about a test, quiz, or assignment to other students. Any student involved in academic dishonesty will receive no credit (0) for work done and/or may be penalized in accordance with published University Rules.

7 Counseling and Accessibility Services

Sul Ross State University is committed to equal access in compliance with the Americans with Disabilities Act of 1973. It is the student's responsibility to initiate a request for accessibility services. Students seeking accessibility services must contact Mary Schwartz, M. Ed., L.P.C., in Counseling and Accessibility Services, Ferguson Hall, Room 112. The mailing address is P.O. Box C-122, Sul Ross State University, Alpine, Texas 79832. Telephone: 432-837-8691. E-mail: mschwartz@sulross.edu.

8 Course Schedule (Tentative)

- **Week 1 (8/23-8/27):** Fundamentals and dealing with uncertainty
 - **Reading:** V&G: Chapter 1
 - Lecture 1: Fundamental ideas, sampling problems, and precision
 - Lab: How big is the population (and our uncertainty in it)?
 - Lecture 2: Estimating population sizes and their uncertainty
 - Discussion: Sources of uncertainty

- **Week 2 (8/30-9/3):** Baby Pop-Dy
 - **Reading:** V&G: Chapter 1
 - Lecture 1: Density-independent and -dependent growth in discrete and continuous time
 - Lab: Simulate, estimate, store, and repeat
 - Lecture 2: Elegant estimates of overly simplistic growth rates
 - Discussion: When to assume what

- **Week 3 (9/6-9/10):** Critical Maths
 - **Reading:** V&G: Chapter 2 p. 57–61
 - Off Monday for Labor Day (No lab this week)
 - Lecture 1: Matrix algebra review
 - Lecture 2: Matrix algebra and simulation in R

- **Week 4 (9/13-9/17):** Structured Population Models 1
 - **Reading:** V&G: Chapter 2 p. 30–48
 - Lecture 1: Structured populations: age, stage, and spatial structure
 - Lab: Forecasting with a speedometer
 - Lecture 2: Formalizing your understanding as a model
 - Discussion: How does your study species work?

- **Week 5 (9/20-9/24):** Structured Population Models 2
 - **Reading:** V&G: Chapter 2 p. 48–57
 - Lecture 1: Inference from structured models
 - Lab: Density dependence in a stage structured population
 - Lecture 2: Generalizing structured models
 - Discussion: How does your study species work (again)?

- **Week 6 (9/27-10/1):** Integrated Population Models
 - **Reading:** Schaub and Adabi 2011
 - Lecture 1: What, why, and how of IPMs
 - Lab: Simulate and fit an IPM
 - Lecture 2: Statsy-stats
 - Discussion: Tradeoffs among modeling frameworks

- **Week 7 (10/4-10/8):** Exam 1
 - Lecture 1: Review (No lab this week)
 - Lecture 2: First Exam
 - Discussion: Discuss exam

- **Week 8 (10/11-10/15):** Applications of simple models
 - **Reading: V&G: Chapter 3**
 - Lecture 1: Life histories and resulting principles
 - Lab: Make predictions from your own hypotheses
 - Lecture 2: Population viability
 - Discussion: How do the things you’ve learned relate to your thesis?

- **Week 9 (10/18-10/22):** Rethink E-V-E-R-Y-T-H-I-N-G
 - **Reading: V&G: Chapter 4**
 - Lecture 1: Equilibrium and other fairy tales
 - Lab: Approaches to tackle non-equilibrium problems
 - Lecture 2: Strange attractors, Eigenvalues, and complicated reality
 - Discussion: Do we really know what we’re doing?

- **Week 10 (10/25-10/29):** Movement and Pop-Dy
 - **Reading:** Hawkes 2009
 - Lecture 1: Disparate origins, oversimplification, and ambiguous definitions of spatially explicit pop-dy.
 - Lab: Movement, selection, and mortality
 - Lecture 2: Less naive modeling approaches for spatial dynamics
 - Discussion:

- **Week 11 (11/1-11/5):** Interactions 1
 - **Reading:**
 - Lecture 1: Competition
 - Lab: Mechanisms of competition
 - Lecture 2: Mutualism
 - Discussions: How do we make better use of these concepts?

- **Week 12 (11/8-11/12):** Interactions 2
 - **Reading:**
 - Lecture 1:
 - Lecture 2:
 - Exercise:

- **Week 13 (11/15-11/19):** Project Presentations
 - **Reading:** None this week
 - Lecture 1: Presentations 1
 - Lecture 2: Presentations 2
 - Exercise: Assigning manuscript reviews

- **Week 14 (11/22-11/26):** Frontiers in Pop-Dy
 - **Reading:** V&G: Chapter 4; p.#–#
 - Lecture 1: Cool things scientists are trying to figure out.
 - Lab: None, enjoy your holiday.
 - Lecture 2: None, due to Thanksgiving holiday
 - Discussion: None, enjoy your holiday.

- **Week 15 (11/29-12/03):** Review
 - No class meetings this week.
- **Week 16 (12/6-12/10):** Final Exam
 - Final exam will be emailed to you. Details TBD.