Quantitative Analysis of Animal Populations (iQAAP)

Instructor: Miguel A. Acevedo

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Web: **elearning.ufl.edu (CANVAS)**
Lab Hours: F Periods 5–6 (11:45am–1:40pm)
Class Hours: Tues and Thurs–Period 9 (4:05–4:55pm)
Class Room: WEIM1098

This syllabus is a broad description of course objectives and plan of work; it is subject to change.

1. **Codification**: WIS 6505C
2. **Credits**: 3 crds
3. **Prerequisites**: STA6093, or a graduate-level introductory statistics course
4. **Course Description**: Quantitative models are useful to explain and predict animal population's patterns and processes. Model's usefulness stems from their ability to synthesize complex processes using a limited number of parameters and assumptions. In this course, students will learn the theory and application of quantitative methods to estimate population level statistics and quantify related uncertainty.
5. **Teaching Philosophy**: As a teacher of quantitative wildlife ecology, my goal is to relieve student's math anxieties by teaching in a welcoming environment where students feel free to learn, ask, and inquire at their own pace. I follow a general active learning framework that includes socratic questioning, group learning exercises, inquiry-based and student-centered learning.
6. **Assumed previous skills**: A common issue with quantitative courses is a mismatch between what the instructor feels the students should know before class and what the students perceive are the assumed skills needed. Here I address this issue by being explicit about the assumed quantitative background. In general, I assume that the students have taken a basic graduate class in statistics like STA6093. I will assume that students who enroll in the class have basic statistical knowledge that includes (summary statistics, t-tests, and hypothesis testing). I will also assume that students have basic knowledge of linear models, but we will explore these in more depth in class. I will not assume that students remember all the details of calculus, but I will assume that students can perform simple algebraic operations. In terms of computational skills, I assume that students had previous exposure to `R` that includes how to assign variables, perform basic statistics, and visualize data (e.g. skills from Data Carpentry).

7. **Course Objectives**: At the completion of this course, students will be able to:

   (a) recognize concepts and vocabulary related to models in wildlife ecology and conservation

   (b) compare and contrast modeling paradigms in wildlife ecology and conservation

   (c) construct models that quantify parameters of interest in wildlife population ecology and management with associated uncertainty

   (d) generate biological knowledge from models

8. **Tentative Course Outline**:

   The weekly coverage might change as it depends on the progress of the class. Notation: P is the paper to be discussed, BR are background readings.

Week	Content
Week 1 (Jan 13–17)	• **Modeling Intro** • Why model? • Introduction to mathematical notation • Lab: Looping in `R` • BR: Hillborn and Mangel 1997 (Chapter 2), Levins 1966, Odenbaugh 2006
Week 2 (Jan 21–24)	• **Probability and Stochastic Distributions** • P: Linden and Mantyniemi 2011 • LAB: Continuous and discrete distributions • BR: Bolker 2008 (Ch 4), Hobbs and Hooten 2014 (Ch 3), Gelman and Hill 2007 (Ch 2) • *Assignment due*: LAB - Looping in `R`
Week 3 (Jan 27–31)	• **Linear models** • **Multiple linear regression** • LAB: Linear models • BR: Quinn and Keough 2003 (Ch 5 and 6) • *Assignment due*: LAB - Continuous and discrete distributions
Week 4 (Feb 3–7)	• **Power Analysis** • P: Peterman 1990 • LAB: Power Analysis • BR: Quinn and Keough 2003 Ch 7; Bolker 2008 Ch 5 • *Assignment due*: LAB - Linear models
Week 5 (Feb 10–14)	• **Maximum Likelihood** • **Model Selection** • LAB: `mle2` • BR: Bolker 2008; Hobbs and Hooten 2014 (Ch 4 and 5) • *Assignment due*: LAB - Power analysis

Week 6 (Feb 17–21)	• **Bayesian Statistics** • P: Elderd et al. 2006 • LAB: Bayes theorem • BR: Dorazio and Johnson 2003; Hobbs and Hooten 2014 (Ch 4 and 5) • *Assignment due*: LAB - Maximum Likelihood
Week 7 (Feb 24–28)	• **Generalized Linear Models (GLMs)** • P: Warton et al. 2016 • LAB: Generalized linear models • BR: Gelman and Hill 2007 (Ch 5 and 6); Agresti 2007 • *Assignment due*: LAB - Bayes theorem
Week 8 (Mar 3–7)	• **Discussion on p-values** • P: Hobbs and Hillborn 2006 • LAB: Debate (P-values vs. alternatives) • BR: Williams et al. 2002 (Ch 14), Kéry and Schaub 2012 (Ch 6) • *Assignment due*: LAB - Generalized Linear Models
Week 9 (Mar 10–14)	• **Abundance estimation of closed populations using mark-recapture I: Lincoln-Peterson and capture models** • P: No paper, exercise mark-recapture on candy • LAB: LP and Capture models • BR: Williams et al. 2002 (Ch 14), Kéry and Schaub 2012 (Ch 6) • *Assignment due*: LAB - P-values vs. alternatives
Week 10 (Mar 17–21)	**Spring Break**
Week 11 (Mar 24–28)	• **Survival estimation: CJS** • P: Pizarro-Muñoz et al. 2018 • LAB: Cormack-Jolly-Seber survival model • BR: Williams et al. 2002 (Ch 15 and 16), Kéry and Schaub 2012 (Ch 7, 8 and 10) • *Assignment due*: LAB - Abundance estimation
Week 12 (Mar 31–Apr 4)	• **Pollock robust design** • P: Chabanne et al. 2017 • LAB: Robust design • BR: Williams et al. 2002 (Ch. 19), Kendall et al. 1997 • *Assignment due*: LAB - Survival estimation
Week 13 (Apr 7–11)	• **Multi-state models for movement, age, and/or diseases** • P: Jones et al. 2016 • LAB: Multi-state model • BR: Williams et al. 2002 (Ch 17), Kéry and Schaub 2012 (Ch 9) • *Assignment due*: LAB - Robust design

Week 14 (Apr 14–18)	• **Occupancy modeling** • P: Louvrier et al. 2017 • LAB: Single-season and multi-season occupancy modeling • BR: Nichols et al. 2007, MacKenzie et al. 2017, Kéry and Schaub 2012 (Ch 13), Royle & Kéry 2007 • *Assignment due*: LAB - Multi-state models
Week 15 (Apr 21–25)	• Meta-analysis • Work on projects • Work on projects • *Assignment due*: LAB - Occupancy modeling
Week 16 (Apr 28–May 2)	• **Group projects presentation (15 mins/each) on *Tuesday Apr. 29* at 4pm** • **Final draft of the project is due on `May 1` before 5 pm.**

Note that we will have a weekly quiz on the paper discussed

9. **Educational Strategies**: We follow an active learning framework that include inquire-based lectures, analysis of the primary literature, computer exercises, group projects and group discussions.

10. **Minimum resources needed by the students**: Computer with `R` and `RStudio` installed [1].

11. **Evaluation strategies**:

Quizzes	20%
Lab exercises	40%
Paper discussion	10%
Final project	20%
Project Presentation	10%

Quizzes: These will be short quizzes on the content of the paper assigned for the group discussion.
Lab exercises: Every week we will have an `R` exercise where we will practice the models discussed during the week's module. These will include examples and problems.
Paper discussion: Most weeks we will discuss a paper from the peer-reviewed literature that applies the models students are learning and practicing. These discussions will be led by students.
Final Project: At the end of the semester students will work on a paper that applies any of the modeling frameworks we learned in class. This paper will be formatted like a manuscript for peer review including introduction, methods, results, discussion, figures, and literature cited. This is a great opportunity for students to practice using their data and work on the analyses for their projects.
Project presentation: Students will present their projects (12 mins) to the group in a mini-symposium. This is a great opportunity to get feedback from their peers.

[1] `R` and `RStudio` are freely available statistical software. https://www.rstudio.com/products/rstudio/

12. **Critical Dates**:

Quizzes	Weekly (due on Wednesdays before 5pm)
Lab exercises	Weekly (due on Thursdays before 5pm)
Paper discussion	One per semester
Project Presentation	Apr 23
Final project	Apr 30

13. **Grading**:

>= 93.00 %	A	90.00–92.99	A-
87.00–89.99	B+	83.00–86.99	B
80.00–82.99	B-	77.00–79.99	C+
73.00–76.99	C	70.00–72.99	C-
67.00–69.99	D+	63.00–66.99	D
60.00–62.99	D-	< 59.99	E

For information on current UF policies for assigning grade points, see https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/.

14. **Textbook**: There is no text required for this course; however, the following books can be used as a guide:

Agresti, A. (2007). An introduction to categorical data analysis, JohnWiley & Sons. Inc., Publication.

Bolker, B. M. (2008). Ecological models and data in R. Princeton University Press.

Clark, J. S. (2007). Models for ecological data: an introduction (Vol. 11). Princeton, New Jersey, USA: Princeton university press.

Fox, G. A., Negrete-Yankelvich, S, and Sosa, V. J. 2015. Ecological Statistics: contemporary theory and applications. Oxford University Press. UK

Hilborn, R. & M. Mangel (1997). The ecological detective: confronting models with data (Vol. 28). Princeton University Press.

Kéry, M. (2010). Introduction to WinBUGS for ecologists: Bayesian approach to regression, ANOVA, mixed models and related analyses. Academic Press.

Kéry, M., & Schaub, M. (2012). Bayesian population analysis using WinBUGS: a hierarchical perspective. Academic Press.

Matthiopoulos, J. (2011). How to be a quantitative ecologist: the'A to R'of green mathematics and statistics. John Wiley & Sons.

Quinn, G. P., & Keough, M. J. (2002). Experimental design and data analysis for biologists. Cambridge university press.

Williams, B. K., Nichols, J. D., & Conroy, M. J. (2002). Analysis and management of wildlife populations.

15. **Bibliography and other resources**:

Chabanne, D. B., Pollock, K. H., Finn, H., & Bejder, L. (2017). Applying the Multistate Capture?recapture Robust Design to characterize metapopulation structure. Methods in Ecology and Evolution.

Christensen, D. L., Herwig, B. R., Schindler, D. E., & Carpenter, S. R. (1996). Impacts of lakeshore residential development on coarse woody debris in north temperate lakes. Ecological Applications, 6(4), 1143-1149.

Daskin, J. H., & Pringle, R. M. (2016). Does primary productivity modulate the indirect effects of large herbivores? A global meta?analysis. Journal of Animal Ecology, 85(4), 857-868.

Dorazio, R. M., & Johnson, F. A. (2003). Bayesian inference and decision theory?a framework for decision making in natural resource management. Ecological Applications, 13(2), 556-563.

Easterling, M. R., Ellner, S. P., & Dixon, P. M. (2000). Size?specific sensitivity: applying a new structured population model. Ecology, 81(3), 694-708.

Elderd, B. D., Dukic, V. M., & Dwyer, G. (2006). Uncertainty in predictions of disease spread and public health responses to bioterrorism and emerging diseases. Proceedings of the National Academy of Sciences, 103(42), 15693-15697.

Gerking, S. D. (1953). Vital statistics of the fish population of Gordy Lake, Indiana. Transactions of the American fisheries Society, 82(1), 48-67.

Guillaumet, A., Woodworth, B. L., Camp, R. J., & Paxton, E. H. (2016). Comparative demographics of a Hawaiian forest bird community. Journal of Avian Biology, 47(2), 185-196.

Hobbs, N. T., & Hilborn, R. (2006). Alternatives to statistical hypothesis testing in ecology: a guide to self teaching. Ecological Applications, 16(1), 5-19.

Holden, M. H., & Ellner, S. P. (2016). Human judgment vs. quantitative models for the management of ecological resources. Ecological Applications, 26(5), 1553-1565.

Jones, A. R., Bull, C. M., Brook, B. W., Wells, K., Pollock, K. H., & Fordham, D. A. (2016). Tick exposure and extreme climate events impact survival and threaten the persistence of a long-lived lizard. Journal of Animal Ecology, 85(2), 598-610.

Karanth, K. U., & Nichols, J. D. (1998). Estimation of tiger densities in India using photographic captures and recaptures. Ecology, 79(8), 2852-2862.

Kendall, W. L., Nichols, J. D., & Hines, J. E. (1997). Estimating temporary emigration using capture-recapture data with Pollock?s robust design. Ecology, 78(2), 563-578.

Koricheva, J., Gurevitch, J., & Mengersen, K. (Eds.). (2013). Handbook of meta-analysis in ecology and evolution. Princeton University Press.

Lentini, P. E., Bird, T. J., Griffiths, S. R., Godinho, L. N., & Wintle, B. A. (2015). A global synthesis of survival estimates for microbats. Biology letters, 11(8), 20150371.

Le Rest, K., Certain, G., Debétencourt, B., & Bretagnolle, V. (2016). Spatio?temporal modelling of auk abundance after the Erika oil spill and implications for conservation. Journal of Applied Ecology, 53(6), 1862-1870.

Levins, R. (1966) The Strategy of Model Building in Population Biology. American Scientist 54: 421-31.

Lindén, A., & Mäntyniemi, S. (2011). Using the negative binomial distribution to model overdispersion in ecological count data. Ecology, 92(7), 1414-1421.

Louvrier, J., Duchamp, C., Lauret, V., Marboutin, E., Cubaynes, S., Choquet, R., ... & Gimenez, O. (2017). Mapping and explaining wolf recolonization in France using dynamic occupancy models and opportunistic data. Ecography.

MacKenzie, D. I., Nichols, J. D., Lachman, G. B., Droege, S., Andrew Royle, J., & Langtimm, C. A. (2002). Estimating site occupancy rates when detection probabilities are less than one. Ecology, 83(8), 2248-2255.

MacKenzie, D. I., Nichols, J. D., Hines, J. E., Knutson, M. G., & Franklin, A. B. (2003). Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly. Ecology, 84(8), 2200-2207.

MacKenzie, D. I., Nichols, J. D., Royle, J. A., Pollock, K. H., Bailey, L., & Hines, J. E. (2017). Occupancy estimation and modeling: inferring patterns and dynamics of species occurrence. Elsevier.

Manel, S., Berthier, P., & Luikart, G. (2002). Detecting wildlife poaching: identifying the origin of individuals with Bayesian assignment tests and multilocus genotypes. Conservation Biology, 16(3), 650-659.

May, R. M. (1978). Host-parasitoid systems in patchy environments: a phenomenological model. The Journal of Animal Ecology, 833-844.

McCullough, D. R., & Hirth, D. H. (1988). Evaluation of the Petersen: Lincoln Estimator for a White-Tailed Deer Population. The Journal of Wildlife Management, 534-544.

Nichols, J. D., Hines, J. E., Mackenzie, D. I., Seamans, M. E., & Gutierrez, R. J. (2007). Occupancy estimation and modeling with multiple states and state uncertainty. Ecology, 88(6), 1395-1400.

Nuzzo, R. (2014). Statistical errors. Nature, 506(13), 150-152.

Odenbaugh, J. (2006). The strategy of "The strategy of model building in population biology". Biology and Philosophy, 21(5), 607-621.

O'Hara, R. B., & Kotze, D. J. (2010). Do not log-transform count data. Methods in Ecology and Evolution, 1 (2), 118–122.

Peterman, R. M. (1990). Statistical power analysis can improve fisheries research and management. Canadian Journal of Fisheries and Aquatic Sciences, 47(1), 2-15.

Pizarro-Muñoz, A. P., Kéry, M., Martins, P. V., & Ferraz, G. (2018). Age effects on survival of Amazon forest birds and the latitudinal gradient in bird survival. The Auk: Ornithological Advances, 135(2), 299-313.

Royle, J. A., & Kéry, M. (2007). A Bayesian state-space formulation of dynamic occupancy models. Ecology, 88(7), 1813-1823.

Vonesh, J. R., & Bolker, B. M. (2005). Compensatory larval responses shift trade-offs associated with predator-induced hatching plasticity. Ecology, 86(6), 1580-1591.

Warton, D. I., Lyons, M., Stoklosa, J., & Ives, A. R. (2016). Three points to consider when choosing a LM or GLM test for count data. Methods in Ecology and Evolution, 7(8), 882-890.

16. **Class attendance and Make-up Work**: Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/.

17. **Online Course Evaluation Process**: Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at: https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens and can complete evaluations through

the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at: https://gatorevals.aa.ufl.edu/public-results/

18. **Academic honesty**: As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "*We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity*." You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "*On my honor, I have neither given nor received unauthorized aid in doing this assignment*."

    t is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

19. **Software use**: All faculty, staff and students of the university are required and expected 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.

20. **In-Class Recording**: Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

    A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

    Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is

considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

21. **Services for Students with Disabilities**: The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

    0001 Reid Hall, 352-392-8565, https://disability.ufl.edu/

22. **Campus Helping Resources** Students experiencing crises or personal problems that interfere with their general well- being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides 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

    (a) University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, http://www.counseling.ufl.edu, Counseling Services, Groups and Workshops, Outreach and Consultation, Self-Help Library, Wellness Coaching.

    (b) U Matter, We care:
    If you or a friend is in distress, please contact umatter@ufl.edu or 352 392- 1575 so that a team member can reach out to the student.

    (c) Career Connections Center, First Floor JWRU, 392-1601, https://career.ufl.edu

    (d) Student Success Initiative, http://studentsuccess.ufl.edu

    (e) Student Complaints: Residential Course: https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/. Online Course: http://www.distance.ufl.edu/student-complaint-process.

23. **Academic Resources**

    (a) E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
    https://lss.at.ufl.edu/help.shtml.

    (b) Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

    (c) Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring .http://teachingcenter.ufl.edu/

(d) Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. http://writing.ufl.edu/writing-studio/