Introduction to the Quantitative Analysis of Wildlife Populations (iQAAP)

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

1. **Codification**: WIS 6934–24034
2. **Credits**: 3 crds
3. **Pre-requirements**: STA6093, or instructor's permission
4. **Course Description**: Quantitative methods are useful to explain and predict animal population 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 am doing my best effort to be explicit about the assumed skills. Hopefully this will be useful. In general, I assume that the students have taken a basic graduate class in statistics like STA6093. I will assume that students that enroll in the class have basic statistical knowledge that includes (summary

statistics, t-test, 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 calculus, but I will assume that students are able to perform simple algebraic operations. In terms of computational skills I assume that students had previous exposure to `R` that includes how to assign variables, how to perform simple statistics and how to make simple figures.

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

   (a) Recognize, compare and contrast concepts and vocabulary related to models in wildlife ecology and conservation.

   (b) Develop models that quantify parameters of interest in wildlife population ecology and management and associated uncertainty

   (c) Synthesize 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 6–10)	• **Modeling Intro** • Why model? • Introduction to mathematical notation • Group assignments • Lab: Looping in `R` • BR: Hillborn and Mangel 1997 (Chapter 2), Levins 1966, Odenbaugh 2006
Week 2 (Jan 13–18)	• **Probability and Stochastic Distributions** • P: May 1978 • LAB: Continuous and discrete distributions • BR: Bolker 2008 (Ch 4), Hobbs and Hooten 2014 (Ch 3), Gelman and Hill 2007 (Ch 2)
Week 3 (Jan 21–24)	• **Linear models** • P: Christensen 1996 • LAB: Linear models • BR:
Week 4 (Jan 27–31)	• **Maximum Likelihood** • P: Vonesh and Bolker 2005 • LAB: `mle2` • BR: Bolker 2008; Hobbs and Hooten 2014 (Ch 4 and 5)
Week 5 (Feb 3–7)	• **Bayesian Statistics** • P: Elderd et al. 2006 • LAB: Bayes theorem • BR: Dorazio and Johnson 2003; Hobbs and Hooten 2014 (Ch 4 and 5)

Week 6 (Feb 10–14)	• **Generalized Linear Models (GLMs)** • P: Dodd and Dorazio 2004 • LAB: Generalized linear models • BR: Gelman and Hill 2007 (Ch 5 and 6); Agresti 2007
Week 7 (Feb 17–21)	• **Abundance estimation of closed populations using mark-recapture I: Lincoln-Peterson** • P: McCullough and Hirth 1998 • LAB: Biases in LP estimator • BR: Williams et al. 2002 (Ch 14), Kéry and Schaub 2012 (Ch 6)
Week 8 (Feb 24–28)	• **Abundance estimation of closed populations using mark-recapture II: Capture models** • P: Karanth and Nichols 1988 • LAB: Capture models • BR: Williams et al. 2002 (Ch 14), Kéry and Schaub 2012 (Ch 6)
Week 9 (Mar 9–13)	• **Survival estimation: CJS** • P: Lentini et al. 2015 • LAB: Cormack-Jolly-Seber survival model • BR: Williams et al. 2002 (Ch 15 and 16), Kéry and Schaub 2012 (Ch 7, 8 and 10)
Week 10 (Mar 16–20)	• **Pollock robust design** • P: Chabanne et al. 2017 • LAB: Robust design • BR: Williams et al. 2002 (Ch. 19), Kendall et al. 1997
Week 11 (Mar 23–27)	• **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)
Week 12 (Mar 31 – Apr 4)	• **Integrated Population Models** • P: Guillaumet et al. 2016 • LAB: IPMs • BR: Kéry and Schaub 2012 (Ch 11), Easterling et al. 2000
Week 13 (Apr 7–10)	• **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
Week 14 (Apr 13–17)	• Meta-analysis (Tues) • Work on projects (Thurs) • Work on projects (Fri)

Week 15 (Apr 20–22)	• **Group projects presentation (15 mins/each)** • **Final draft of the project is due on April 24 before 5 pm.**

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[1].

10. **Minimum resources available**: Lecture room, audio-visual equipment.

11. **Evaluation strategies**[2]:

Quizzes	20% (best 10 out of 12)
Lab exercises	40%
Paper discussion	10%
Project Presentation	10%
Final project	20%

12. **Critical Dates**:

Quizzes	Weekly due on Thurs. at 11am
Lab exercises	Weekly due on Thurs. before 4pm
Paper discussion	One per semester
Project Presentation	Week 15
Final project	Apr 24 at 5pm

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

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

[1] We will make all necessary arrangements for students with spacial needs
[2] These will be adapted accordingly for students with special needs

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.

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.

Dodd Jr, C. K., & Dorazio, R. M. (2004). Using counts to simultaneously estimate abundance and detection probabilities in a salamander community. Herpetologica, 60(4), 468-478.

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.

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.

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.

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.

16. **Class attendance and demeanor policy**: All students are expected to attend every class and lab sessions. Students are responsible for the materials and information presented. Students who miss class for a UF approved reason (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) will be able to make-up quizzes from that day. Unexcused late assignments will have 10% of the point total for that assignment deducted for each day late. Late assignments will not be accepted beyond 3 days post-due date. A professional attitude is expected in all lectures and labs. Please do not disturb your fellow students by talking during class. Please minimize electronic distractions by silencing cell phones. While we will actively use computer resources in class and lab, it is strongly recommended that students focus on course material and minimize distractions from e-mail and social networking sites. Make-up eassignment/homework/quiz problems will not be given for unexcused absences. An acceptable excuse (meeting guidelines from the UF handbook) must be submitted to be eligible for a make-up.

17. **Rights of students with special needs**: The University of Florida meets all federal and state laws regarding discrimination including the American Disabilities Act (ADA Law). Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, http://www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

18. **Student evaluations**: Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/.

19. **Academic honesty**: As a result of completing the registration form at the University of Florida, every student has signed the following statement: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students 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." The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class."

20. **UF counseling services**: The University of Florida provides excellent resources on campus for students having personal problems or seeking additional career and academic assistance to help them realize their full potential. The University cares about you and your well-being. These resources include:

    (a) 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.

    (b) Counseling and Wellness Center:
    https://counseling.ufl.edu/, 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

    (c) Sexual Assault Recovery Services (SARS)
    Student Health Care Center, 392-1161.

    (d) University Police Department, 392-1111 (or 9-1-1 for emergencies).
    http://www.police.ufl.edu/

21. **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) Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. http://www.crc.ufl.edu/

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

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

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

(f) Student Complaints On-Campus: https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/

(g) On-Line Students Complaints: http://distance.ufl.edu/student-complaint-process/

22. **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.