FISH/SEFS 557: Demographic Estimation and Modeling
Credits: 4
Winter 2022 (taught winter of even years)

1. Description

This course will provide you with knowledge and practical skills in demographic estimation and modeling, with a focus on capture-recapture modeling. Capture-recapture models are foundational tools for the types of demographic analyses that are key to wildlife and freshwater fisheries science and management. More recently, capture-recapture models have served an important role in the development of integrated approaches to demographic analysis, and this course will also provide you with an understanding and practical skills in integrated population modeling. We will emphasize hands-on practice so that students are able to build and implement models for the analysis of capture-recapture and other types of demographic data in a flexible Bayesian platform (JAGS) that facilitates extension of these models for a vast variety of applications. We will use example datasets from both wildlife and freshwater fisheries.

2. Learning Objectives

The aim of this course is to give you the understanding and skills you need to analyze basic types of capture-recapture data, and to provide you with practical tools that will allow you to expand these basic analyses as needed for your graduate research and your future career. With this in mind, we teach the course in JAGS, which provides a great deal of flexibility for customizing models.

By the end of this course, students should be able to:
1. Understand the foundations and assumptions of capture-recapture models, make determinations on what model to select given a biological problem and sampling situation, and evaluate whether different experimental designs satisfy model assumptions.
2. Understand the foundations and assumptions of integrated population models, including matrix population models and associated population growth equations, and determine the approaches necessary to fit these models in a variety of sampling situations.
3. Create a variety of closed and open capture-recapture models, including spatial capture-recapture models, in the JAGS language, implement the models, and interpret the results.
4. Create basic integrated population models in the JAGS language, implement the models, and interpret the results.

3. Course Instructors

Beth Gardner School of Environmental and Forest Sciences 123D Anderson Hall 206-685-9995 bg43@uw.edu	Sarah Converse School of Environmental and Forest Sciences & School of Aquatic and Fishery Sciences 220B Fishery Sciences 206-221-5791 sconver@uw.edu

Instructors can be contacted by email or on the Canvas discussion board.

4. Meeting Times, Location, and Office Hours

- Class meets Monday and Wednesday, 10:30am – 12:20pm in FSH 213.
- Beth's office hours: by appointment (please email or stop by after lecture so we can schedule a time to meet)
- Sarah's office hours: by appointment (please email or stop by after lecture so we can schedule a time to meet)

5. Textbook and Readings

- Required: none
- Recommended: M Kéry and M Schaub. 2012. Bayesian population analysis using WinBUGS. (Code, errata, etc. here: www.vogelwarte.ch/de/projekte/publikationen/bpa/)
- Instructors will assign additional readings as needed. Please consult Canvas and complete readings before lecture. Readings will be available at least one week before lectures.

6. Technology

We will provide all course materials on Canvas. The course website is: XXX. Lectures will be posted on Canvas prior to class, and all readings will be posted on Canvas at least one week ahead of class. Weekly quizzes will be delivered on Canvas.

Please bring a laptop to class with you. Consult the instructors if you need to borrow a laptop for the quarter – loans are available. Your laptop should have R installed, as well as JAGS. You can get JAGS at https://mcmc-jags.sourceforge.io/ and find a useful resource for getting started with JAGS at https://www.r-bloggers.com/2012/04/getting-started-with-jags-rjags-and-bayesian-modelling/.

7. Teaching Methodology

In-class Lecture and Practice: Course meetings will consist of a mix of lectures and hands-on model building. We will introduce content in lecture to build your understanding of concepts and then demonstrate applications in class. To get the most out of lecture, you should complete any assigned readings before class. We encourage you to download lectures from Canvas before coming to class. To build practical skills, we will provide ample time for you to build and implement models and interpret results in class. We encourage course participants to work together both inside and outside class to practice model building and implementation.

Practice Problems: We will post practice problems each week. Practice problems will be intended to challenge you and make you think critically and creatively about the course material. We encourage you to work in groups on these problems, but please make sure you are prepared to take the quizzes independently. Answers to practice problems will be posted.

Quizzes: Quizzes will be given at the end of each week based on the material delivered during that week. Quizzes will be available on Canvas from 8am Thursday mornings until 5pm on the same day. Quizzes will have a 30-minute time limit and you are expected to work on the quizzes independently. Because course content builds in complexity, quizzes are an important tool for you and for the instructors to check that you are understanding foundational concepts. Quizzes will be a mix of multiple choice and short answer - you may be asked to scan and upload written work.

Exams: Exams will be take-home, hands-on problem sets. There will typically be 2-3 problems per exam. Each problem will require you to build a model based on information and data provided, implement the model, and interpret the results. Exams will be available on the Wednesday of exam week after class and will be due the following Monday before class, i.e., you will have 5 days to complete exams. You must work independently on exams.

8. Coursework and Grades

Quizzes	50%
Mid-term Exam	25%
Final Exam	25%
TOTAL	100%

There will be 8 quizzes and your quiz grade will be based on your 6 highest quiz scores. No make-up quizzes will be given. **Final grades** will be converted from a percentage to a grade based on the chart below.

100-98%	97-96%	95-94%	93-92%	91%	90-89%	88-87%	86%	85%
4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2
84%	83%	82%	81%	80%	79%	78%	77%	76%
3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4	2.3
75%	74%	73%	72%	71%	70%	69-0%		
2.2	2.1	2.0	1.9	1.8	1.7	0.0		

9. Inclusivity

The University of Washington supports an inclusive learning environment where diverse perspectives are recognized, respected, and seen as a source of strength. In this course, we will strive to create welcoming spaces where everyone feels included and engaged regardless of their social and cultural backgrounds.

10. Policy on Missed Work and Excused Absences

Completing exams on time is required. The only exceptions will be excused absences associated with religious holidays, pre-approved professional activities, or an injury or illness of the student or immediate family member. A makeup exam will be given in these cases. Verification of these events will be needed. Notification of anticipated absences should occur as early as possible.

Because we are dropping the 2 lowest quiz grades, we will not give make-up quizzes.

11. Accommodations

Disability Accommodations
It is the policy and practice of the University of Washington to create accessible learning environments consistent with federal and state law, including establishing reasonable accommodations for all students. If you have already established accommodations with Disability Resources for Students (DRS), please activate your accommodations via myDRS so that we can discuss how they will be implemented in this course.
If you have not yet established services through DRS, and you have a temporary health condition or permanent disability that requires accommodations, contact DRS directly (disability.uw.edu) to set up an Access Plan. DRS facilitates the interactive process that establishes reasonable accommodations. Conditions requiring accommodation include but are not limited to mental health, attention-related, learning, vision, hearing, physical or health impacts.
In assessing whether you require reasonable accommodations through DRS, please note that full participation in this course requires the following types of engagement:

1. The ability to attend 2 2-hour lecture and hands-on sessions each week.
2. The ability to complete online quizzes.
3. The ability to complete take-home exams.

Religious Accommodations
Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form

12. Academic Integrity

We expect graduate students to adopt the strict academic integrity standards of professional scientists as well as to adhere to the University Student Conduct Code. This requires that your work reflects your own intellectual efforts. Presenting someone else's work as your own represents academic misconduct, as does assisting someone else in committing academic misconduct. The Student Conduct Code defines prohibited conduct and describes how the University holds students accountable (WAC 478-121). All suspected cases of academic misconduct will be handled according to University regulations.

In this course, it is critical that you:

1. Cite any literature that informs your responses on exams. The instructors reserve the right to deduct some or all points on exam questions if sources are not cited.
2. Take quizzes independently on Canvas. If students work together on quizzes, we will report these cases of academic misconduct to the appropriate Dean representative and if the student is found responsible for misconduct, the grade on the assignment will be a 0.

3. Take exams independently on Canvas. If students work together on exams, we will report these cases of academic misconduct to the appropriate Dean representative and if the student is found responsible for misconduct, the grade on the assignment will be a 0.

14. Safety

Call SafeCampus at 206-685-7233 anytime – no matter where you work or study – to anonymously discuss safety and well-being concerns for yourself or others. SafeCampus's team of caring professionals will provide individualized support, while discussing short- and long-term solutions and connecting you with additional resources when requested.

15. Schedule

Week	Day	Date	Topic
1	M	1/3	Introduction to demographic analysis
	W	1/5	Introduction to demographic data sources
	Th	1/6	**[Quiz on Canvas – available between 8am and 5pm]**
2	M	1/10	Bayesian inference and introduction to JAGS
	W	1/12	Introduction to JAGS, continued
	Th	1/13	**[Quiz on Canvas – available between 8am and 5pm]**
3	M	1/17	Martin Luther King Day
	W	1/19	Data simulation
	Th	1/20	**[Quiz on Canvas – available between 8am and 5pm]**
4	M	1/24	Closed models for abundance estimation
	W	1/26	Variations on closed models: behavioral responses and heterogeneity
	Th	1/27	**[Quiz on Canvas – available between 8am and 5pm]**
5	M	1/31	Spatial capture-recapture for density estimation
	W	2/2	Spatial capture-recapture, continued **[Mid-term exam handed out, due 2/7]**
6	M	2/7	Open models for survival estimation: Cormack-Jolly-Seber
	W	2/9	Open models, continued: Multi-state and multi-event models
	Th	2/10	**[Quiz on Canvas – available between 8am and 5pm]**
7	M	2/14	Open models for survival and abundance estimation: Jolly-Seber
	W	2/16	Open spatial capture-recapture models
	Th	2/17	**[Quiz on Canvas – available between 8am and 5pm]**
8	M	2/21	President's Day
	W	2/23	Data integration: general concepts
	Th	2/24	**[Quiz on Canvas – available between 8am and 5pm]**
9	M	2/28	Introduction to matrix population models and growth equations
	W	3/2	Integrated population models
	Th	3/3	**[Quiz on Canvas – available between 8am and 5pm]**
10	M	3/7	Integrated population models, continued
	W	3/9	Future directions in demographic analysis and course close-out **[Final exam handed out, due 3/14]**