Auburn University
Entomology and Plant Pathology / Biology

ENTM 7230, Practical Evolution

Instructor

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The easiest way to reach me is through email. I'll usually respond within a day.

General Course Information

Canvas URL: https://aub.ie/evolve

Classroom: Funchess 358
Lecture time: MW 11am-12:15pm.
Prerequisites: BIOL 5800/6800 or BIOL 7180. These can be waved with permission. If you don't have any previous coding experience, you should do the mini-bridge module offered the week before the semester begins. To do that, just shoot me an email.

Course Description

Students will learn evolutionary biology by making it happen, that is, by building and running simulation models. They will also learn of opportunities to apply evolutionary theory to practical problems in agriculture, public health and conservation. Our simulation approach aims to make evolutionary biology intuitive, realistic, and practical.

Course Format and Instructional Methods

This is a blended course; we will use a mix of face-to-face and online teaching modalities. We will use Canvas, Auburn's learning management system, to host lesson materials and assessments, manage the submission of assignments, and coordinate team-based learning activities. We will use face-to-face sessions to reiterate key concepts, and to work together to apply those concepts in simulation models.

Student Learning Outcomes (SLOs)

Upon successful completion of this course, students will be able to:

- SLO1. Describe and interpret fundamental theories in evolutionary population biology.
- SLO2. Use simulations to test and extend that theory.
- SLO3. Apply population biology approaches to real-world problems.

Required Texts/Softwares

All required readings are provided as Canvas Pages. For our simulations, we will be using R and the SLiM 3 (Selection on Linked Mutations) framework. The SLiM 3 manual will be invaluable.

Lesson pull from the primary research literature and two text books: (1) Nielsen and Slatkin. 2013. *An Introduction to Populations Genetics*, and (2) Templeton. 2006. *Population Genetics and Microevolutionary Theory*. Neither text is required but students may find them helpful.

Other Equipment

SliM 3 is free software that runs on 'Nix based operating systems (i.e., Linux and Mac computers). Students without a suitable machine can use computing resources on campus (see below).

Classroom Protocol

Canvas lessons should be completed prior to face-to-face meetings. Cell-phone use in class is not permitted unless otherwise noted.

Course Schedule

Here is a week-by-week breakdown of what to expect. Topics are in bold, and learning activities are in italics. Abbreviations: RAT, Readiness Assurance Test; CQ, Collaborative Quiz; TW, Team Work.

RATs should be completed by each student before the corresponding lecture. CQs are taken twice, first by each student before lecture, and then again, in lecture, after students have had a chance to talk things over with their learning teammates. Scores are the average of the two attempts. TWs are done by teams in class.

Week 1	**Contemporary evolution in a changing world; Introduction to simulation models and SliM 3; Basic probability theory**
Learning Activities	*Form teams; RAT: Evolutionary Vocabulary; Install software; RAT: Basic Probability*
Week 2	**Neutral evolution in a panmictic population**
Learning Activities	*RAT: Allele and genotype frequencies; CQ: Predicting neutral evolution; RAT: Using the SLiM GUI; TW: SLiM coding; TW Modeling neutral evolution in SliM*
Week 3	**Demography and population structure; Natural selection**
Learning Activities	*TW: Adding population structure to neutral models; CQ: Predicting selection in haploids*
Week 4	**Selective Sweeps**
Learning Activities	*CQ: Predicting selection in diploids; TW: Modeling selection in SLiM*
Week 5	**Genetic architecture; Linkage; Midterm 1**
Learning Activities	*CQ: Add genetic architecture to pop. gen. Models; TW: Genetic hitchhiking*
Week 6	**Quantitative genetics; Epistasis and evolvability; Pleiotropy and specialization**
Learning Activities	*CQ: Survival of the flattest; TW: Messing with quantitative genetics; CQ: Density-dependent selection; TW: Modeling rugged adaptive topographies*
Week 7	**Units and targets of selection; Gene drive; Group selection**
Learning Activities	*RAT: Know your targets of selection; CQ: Aiming selection; TW: Simulating*

	sex-ratio evolution
Week 8	**Phenotypic plasticity; Selection in changing environments**
Learning Activities	*CQ: Clines; TW: Modeling selection in mixed environments*
Week 9	**Going beyond Wright-Fisher models; Evolutionary rescue; Coevolution**
Learning Activities	*RAT: Mutational Meltdown; TW: Effects of reproductive mode on evolutionary rescue; TW: Modeling co-evolution*
Week 10	**Midterm 2**
Learning Activities	*TW: Project Work*
Week 11	**Evolution now: Climate change**
Learning Activities	*TW: Project work*
Week 12	**Evolution now: Pesticide and antibiotic resistance**
Learning Activities	*TW: Project work*
Week 13	**Evolution now: Pathogenicity and virulence**
Learning Activities	*TW: Project work*
Week 14	**Evolution now: Invasive species**
Learning Activities	*TW: Project work; Draft written project report due*
Week 15	**Student-team research seminars and reports; Course wrap-up**

Course assessments

- Routine Learning Exercises (125 points). Assessment of SLO and SLO2. Each week, students will work through a mix of three types of learning activities. Readiness Assurance Tests (RATs) are completed by each student before the corresponding lecture. They are meant to ensure that each student is prepared for the other, more collaborative types of learning activities. Collaborative Quizzes (CQs) are taken twice by each student, first before lecture, and then again in lecture, after students have had a chance to talk things over with their learning teammates. They are meant to provide scaffolded opportunities for students to work and learn together. Scores are the average of the two attempts. Team Works (TWs) are done by teams in

class. In comparison to CQs they present more open-ended learning challenges. There are total of 20 routine learning exercises. Each is worth five points.

- Exams (100 points). Assessment of SLO1 and SLO3. There will be two midterm exams, each worth 50 points. These will cover the theory of evolutionary biology, not the details of simulating it.
- Final Team Projects (60 points). Assessment of SLO2 and SLO3. Students in project teams will work together to pose their own practical question about contemporary evolution. They will then address that question with population genetic simulation. Teams will present their research in a short written report, and with a short oral presentation during the last week of the course. Written reports should be ~2000 words, and follow the typical format for a scientific research article: an abstract, introduction, methods, and combined results and discussion. Simulation codes must be included in an appendix. Oral presentations are 10 minutes long and are followed by 5 minutes of questions. Rubrics are given below. Fifty possible points are divided evenly between the written and oral presentations. An additional five points each are awarded for proposing a project idea before Week 11, and for submitting a draft of the written report before Week 14. I'll provide feedback on reports submitted before then that can be incorporated into a revised final report.
- Class participation (40 points). Students can earn up to 40 points for overall positive and courteous engagement.
- There is no final exam.

Grading Policy

The sum of assessment scores is 325 points. Student grades are determined by the proportion of those points they earn.

90%-100% = A
80%-89% = B
70%-79% = C
60%-69% = D
<60% = F

Students will receive no points for missing work. Late work will be penalized one letter grade per day past the due date.

University Policies

For information about policies for adding or dropping the course, cheating and plagiarism, grade appeals, and accommodations for student with disabilities, please consult the AU policy statements http://bulletin.auburn.edu/undergraduate/generalintroduction/academicpolicies/. I aim to foster a fair and inclusive learning environment. If a student faces special learning challenges, we will do what we can to help. On the other hand, students who cheat or otherwise undermine our learning environment will face steep consequences.

Additional Resources

Library Support

You should be able to complete this course without making a trip to the library. That being said, be advised that the Auburn University Library can help you find information and conduct research. If you would like help pursuing a topic that we touched on, you can make an appointment with a librarian, or get help online. The specialist for Biology is Patricia Hartman (pjh0011@auburn.edu).

Miller Writing Center

Students in this course will write a research report. Be advised that The Miller Writing Center helps Auburn University students become better writers and produce better written documents. The MWC has multiple locations: RBD Library, SADC, Multicultural Center, Forestry & Wildlife Building, and Auburn Global. Their tutors can help you with a wide array of concerns, from generating good ideas and organizing papers more clearly to learning citation formats and using semi-colons correctly. Visit the Writing Center website http://wp.auburn.edu/writing/writing-center/ for more information on how to schedule time with a tutor.

Computing

Review the information posted at OIT Computing Lab Locations http://www.auburn.edu/oit/labs/. There you will find computer use guidelines and a list of available computer labs.

Canvas

Canvas is Auburn University's official Learning Management System (LMS). Canvas is the place where you will find the course syllabus, read posted announcements, submit your assignments online and view the materials for this course. To access Canvas use your AU user ID and password to log into Auburn's Canvas homepage https://auburn.instructure.com/login/ldap. When you log in, you will be directed to your dashboard. Click on the link for this course (classes are listed by course name and number). Note that the Login link is also conveniently located in AU Access www.auaccess.auburn.edu and many other university pages.

If you need help with Canvas, contact the OIT Help desk https://oit.auburn.edu/helpdesk if you need assistance with Canvas or other information about computing and information technology at Auburn. Three ways to contact the OIT Help Desk are:

- Call: 334-844-4944
- Email: helpdesk@auburn.edu
- Visit Location: RBD Library, 2nd and 3rd floors

Student Counseling Services

SCS is a unit of the Auburn University Medical Clinic. SCS offers confidential counseling to students experiencing personal problems that interfere with their academic progress, career or well being. The SCS website http://wp.auburn.edu/scs/ provides information only. If you would like to talk with

someone or make an appointment, please call (344) 844-5123 during business hours, or (344) 501-3100 after hours or on weekends.

Face Coverings – Fall 2022

As of July 2022, Omicron BA.5 is the dominant variant of the SARS-CoV-2 virus. This is the most transmissible variant yet. It also seems to be fairly adept at evading antibodies produced by vaccines and previous infections. The good news is that it also seems to be less virulent than Alpha and Delta strains. Auburn students are not required to be vaccinated or boosted or to disclosure their vaccination status. But those are good strategies for reducing your chances of catching COVID. The university permits face-to-face instructors to mandate face coverings. We'll play things by ear. I won't require them at the start. But I reserve the right to enforce a mask policy at any point.

Rubrics.

Written Research Report			
Team:			
Each of the 16 elements below will be rated on a scale of **1**-**5**, where **1**=strongly disagree, and **5**=strongly agree			
		Score	**Comments**
A	**Content**		
1	Background information justifies research.		
2	Relevant previous research summarized.		
3	Questions and hypotheses are compelling.		
4	Objectives are logical.		
5	Methods are appropriate. Coding is sound.		
6	Methods are clearly explained. Codes are commented.		
7	Interpretation of results is logical.		
8	Significance is accurately assessed.		
B	**Presentation**		
1	Manuscript is well organized.		
2	Appropriate emphasis is given.		
3	Narrative has smooth flow.		
4	Writing is clear.		
5	Grammar is sound.		
6	Illustrations are effective.		
7	Editorial suggests were well handled.		
8	Main message is clear.		
C	**Total score (sum of element scores) =**	(/80) * 25	

Oral Research Presentation			
Team:			
Each of the 16 elements below will be rated on a scale of **1-5**, where **1**=strongly disagree, and **5**=strongly agree			
		Score	**Comments**
A	**Content**		
1	Background information justifies research.		
2	Relevant previous research summarized.		
3	Questions and hypotheses are compelling.		
4	Objectives are logical.		
5	Methods are appropriate.		
6	Methods are clearly explained.		
7	Interpretation of results is logical.		
8	Significance is accurately assessed.		
B	**Presentation**		
1	Talk is well organized.		
2	Appropriate emphasis is given.		
3	Narrative has smooth flow.		
4	Speech is clear.		
5	Speaker is composed.		
6	Illustrations are effective.		
7	Questions are well handled.		
8	Main message is clear.		
C	**Total score (sum of element scores) =**	(/80) *25	