MATH 115, Spring 2020: Quantitative Biology

Instructors	Dr. Maggie Rahmoeller Trexler Hall 270J *Email:* rahmoeller@roanoke.edu
Class Meetings	Mondays, Wednesdays, Fridays: 10:50 AM - 11:50 AM in Lucas 110
Office Hours	By appointment only through https://drmaggie.youcanbook.me/ Mon: 9:30AM - 10:30AM Tues/Thurs: 3PM - 4PM Wed/Fri: 1:30PM - 3PM Email me if none of the available times work.

Course Information

This course is focused for students intending to pursue a degree in the biological sciences. The course builds upon statistics knowledge gained in INQ 240 and offers an introduction to mathematical modeling - both continuous and discrete. Students will learn how to apply appropriate models and statistical tests to a variety of situations.

Intended Learning Outcomes

By the end of this course, successful students will be able to:

• Given a research question or data set, choose an appropriate statistical test to use.

• Research, find, and utilize additional statistical tests outside of those found in INQ 240 or this course.

• Understand the concepts of a derivative and its importance in mathematical modeling.

• Understand the terms that appear in mathematical models relevant to biology and apply those models in appropriate ways.

• Understand the mathematics and statistics present in selected biology research papers.

Required Materials

Textbook 1: Mathematics for the Life Sciences; Bodine, Lenhart, and Gross
Textbook 2: Handbook of Biological Statistics; McDonald, http://www.biostathandbook.com/
Calculator: TI-83 Calculator, or similar (with graphing capabilities)
Laptop: We will use the statistical software R and the modeling software NetLogo for this class.

Participation and Make-Up Work

Students are expected to attend every class. Any absence that is not discussed with the instructor prior to the missed class is considered unexcused. Unexcused absences may result in the lowering of the final grade (for example, a B to a B-). When absent, excused or unexcused, you are responsible for all material covered in class. **You will not be allowed to make up any work missed due to an unexcused absence.**

Commitment Hours

This course expects you to spend at least 12 hours of work each week inside and outside of class.

Course Grades

The following table lists the weights for the various forms of assessment for this class. A grade scale will be determined after final grades are computed, but will be no worse than the given scale

Homework / Assignments	15%	Tests	20%
Research Articles	10%	Case Study Explorations	30%
Project - Paper & Presentation	25%		

below. Attendance and class participation will be considered when determining marginal grades.

		B+	87-89	C+	77-79	D+	67-69		
A	93-100	B	83-86	C	73-76	D	63-66	F	0-59
A-	90-92	B-	80-82	C-	70-72	D-	60-62		

Homework / Assignments

Homework will be assigned regularly in this class (virtually every class period) and may take several forms. Typically, it will be due at the start of the class period immediately following the assigning of the homework. Homework will be graded partly on effort and partly on correctness. Late homework is not accepted. If you miss class, either take a picture and email it to me or get a friend to turn in your homework for you.

Occasionally we will do activities in class. I may collect these in-class assignments (especially ones that must be completed outside of class) for a grade and as a chance to offer you feedback.

Research Articles

You will examine two Biology research papers. One paper will be based on statistical analysis of data and the other will focus on mathematical modeling. Articles will be provided along with guided reading questions.

Project

There will be one semester-long project that will be divided into two parts. The first part will assess your understanding of statistical analysis. The second part will assess your understanding of modeling a scenario based on assumptions about scientific principles that underlie the phenomena being modeled. For each part, you will work in groups of two. At the end of the semester, you will present your work in groups of four and each of you will individually write a paper. Detailed information will be covered in class and posted on Inquire.

Tests

There will be two in-class written tests. The first test will emphasize concepts about statistics (test selection - when to use what hypothesis test, assumptions for tests, data transformations, terminology, etc.). The second test will emphasize both concepts about modeling (describing differential equations, rates of change and instantaneous rates of change, equilibrium and stability, etc.) and computation for modeling.

Case Study Explorations

Six case studies will be explored using various computer programs. These will be conducted during class, and you will work in assigned teams of two. If you know you will be missing class on one of the case study exploration days, let me know BEFORE that day and I will allow independent work at a different time. If you miss class unexpectedly on one of the case exploration days, you must email me within 24 hours to schedule a make-up for this assignment.

Final Exam

Instead of a final exam, the exam slot will be used for the term project presentations and discussion. The exam slot is for Block 3, i.e. Monday, April 27 from 8:30 - 11:30AM.

Academic Integrity

Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be your own work! No electronic devices other than calculators can be taken out during any class or testing period (this includes cell phones) unless written consent is given by the professor. Note that looking at or using your cell phone during a test or quiz is considered a violation of Academic Integrity regardless of your purpose or intent in doing so.

| Accessible Education Services | Accessible Education Services (AES) is located in the Goode-Pasfield Center for Learning and Teaching in Fintel Library. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Laura Leonard, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Laura Leonard at your earliest convenience to schedule an appointment. |

Mon	Jan 13	Introduction to Class	
Wed	Jan 15	Asking Statistical Questions	
Fri	Jan 17	Regression - Review	*INQ 240 Review - Part 1 Due*
Mon	Jan 20	Regression	*Statistics Research Article Assigned*
Wed	Jan 22	Regression	
Fri	Jan 24	**Case Study 1**	
Mon	Jan 27	Regression	*Statistics Research Article Due*
Wed	Jan 29	Regression - Nonlinear	
Fri	Jan 31	Logistic Regression	
Mon	Feb 3	Logistic Regression	
Wed	Feb 5	Logistic Regression	*Project - 1st half assigned*
Fri	Feb 7	Project Work Day - in-class	
Mon	Feb 10	Designing Experiments	*INQ 240 Review - Part 2 Due*
Wed	Feb 12	**Case Study 2**	
Fri	Feb 14	1-Sample t-Test	
Mon	Feb 17	2-Sample t-Tests & Paired t-Test	
Wed	Feb 19	2-Sample t-Tests & Paired t-Test	
Fri	Feb 21	ANOVA	
Mon	Feb 24	**Case Study 3**	
Wed	Feb 26	ANOVA	*INQ 240 Review - Part 3 Due*
Fri	Feb 28	**Test 1**	
		Spring Break	
Mon	Mar 9	Chi Square Test of Independence	*Project - 1st half of pres / paper due*
Wed	Mar 11	Chi Square Goodness-of-Fit Test	
Fri	Mar 13	**Case Study 4**	
Mon	Mar 16	Discrete Models (Ch 6 & 8)	*Project - 2nd half assigned*
Wed	Mar 18	Transfer Models (Ch 6 & 8)	
Fri	Mar 20	Transfer Models	
Mon	Mar 23	Leslie Matrices (Ch 9)	
Wed	Mar 25	Leslie Matrices	
Fri	Mar 27	Eigenvalues & Eigenvectors	

Tentative Course The following schedule is approximate and subject to change, except for the test dates: Schedule

Mon	Mar 30	Exponents & Logarithms (Ch 4)	
Wed	Apr 1	**Case Study 5**	
Fri	Apr 3	Rates of Change (Ch 17 & 18)	*Project - 2nd half of pres / paper due*
Mon	Apr 6	Rates of Change	*Modeling Research Article Assigned*
Wed	Apr 8	Limited Population Growth (Ch 27)	
Fri	Apr 10	**No Class!!**	
Mon	Apr 13	Limited Population Growth	*Modeling Research Article Due*
Wed	Apr 15	Counting Methods	
Fri	Apr 17	**Case Study 6**	*Project - entire pres / paper due*
Mon	Apr 20	**Test 2**	
Mon	**April 27**	**Presentations**	**8:30 - 11:30AM**