

Math 115: Quantitative Biology

2023

Modeling Life, Garfinkel/Shentsov/Guo and

Handbook of Biological Statistics, McDonald (<http://www.biostathandbook.com/>)

Dr. Roland Minton, Trexler 270-C, 375-2358,

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Course Objectives: *Learn mathematical and statistical concepts that have been helpful to biologists.* Mathematics is a problem-solving discipline, and the ideas that have been developed are essential to understanding our world. The focus here will be on concepts and simple applications of those concepts to biological situations.

Intended Learning Outcomes: At the end of the course, successful students will be able to

- Use calculus concepts to model and solve problems
- Apply basic modeling techniques to epidemiology and other applications
- Identify which of several statistical models is most relevant for a given problem
- Research and analyze a real world problem quantitatively

Attendance Policy: Attendance and attention in class are essential! Work hard in class and you will have little need for studying the night before a quiz. You are responsible for everything done in class, through attendance and sharing class notes with classmates. If you miss a class, e-mail or call me before class is over and explain why. With the first unexplained absence, you and your advisor and the registrar will be warned that another unexplained absence will result in removal from the course. **If you have two unexplained absences, you will be dropped from the course.**

Equipment: We will use R extensively for statistical analysis of data sets. We will use Mathematica for some messy calculations. Both are available for free. You should have a graphing calculator available for graphing and for basic calculations. Instructions will be given on the use of R, including how to download it.

Study Problems: Problems from the books and handouts will give you problems to practice on. Similar problems will be on the quizzes. Work as many of these problems as you can and ask questions about those you are not sure about!

Worksheets and Quizzes: There will be activities to be completed in-class on most days. These worksheets will be handed in and graded on a scale of 0 to 3 based on effort. In place of a test, there will be four half-hour quizzes on the modeling material.

Homework and Project: There will be five homework assignments to be completed and turned in on the statistics material. You will have class time to ask questions – use this time wisely! All work is to be individual, no help from any resources, human or online, other than your group partner. There will be two projects. The first is a modeling project that will require some understanding of Mathematica, though you will not have to use it yourself. The second project will require the use of R. There will be preliminary assignments to get you acquainted with R, and numerous examples will be given in class. The second project will be in groups and result in a paper and presentation. Both projects will be in groups of two; you will have some choice of partners but they must be different for the two projects.

Make-ups: In case of sickness or scheduling conflicts, get in touch with me ASAP. Make-ups are easiest to plan in advance and will not be given unless scheduled in a timely fashion.

I expect you to spend at least 12 hours of work each week inside and outside of class.

Grading:

Quizzes: 20%

Worksheets, MCSP, Participation: 10%

Homework: 20%

Project 1: 20%

Project 2 (including presentation): 30%

Grades may be curved up based on extenuating circumstances, including improvement as the semester goes on.

A: 93-100 A-: 90-92 B+: 87-89 B : 83-86 B-: 80-82

C+: 77-79 C: 73-76 C-: 70-72 D+: 67-69 D: 63-67 D-: 60-62 F: 59 and below

Community: Welcome back to Roanoke College! Please take the time to get to know your fellow students. They can be a great resource for you! Utilize office hours and all opportunities to ask questions and get help from me. Get involved with campus activities! If you are interested in sports and sports analytics (*Moneyball*) ask me for information on Stat Crew.

Co-Curricular: During the course of the semester, you must “attend” at least two co-curricular events approved by the MCSP department (or other quantitative talk approved by me). Write a two-paragraph reflection paper, giving a brief summary of the talk and expanding on some aspect of particular interest to you. One report must be turned in before spring break.

Academic Integrity: The college policy is fully supported. Tests are closed notes, closed book unless noted. Electronic devices other than computers are not allowed in test situations, and computers may only be used for computation purposes in Mathematica.

Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4-9 PM, Sunday-Thursday. Subject Tutors are highly trained, current students who offer free, one-on-one (and small group) tutorials in over 80 courses taught at Roanoke College, including: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, and Social Sciences. Check out all available subjects and schedule 30- or 60-minute appointments at www.roanoke.edu/tutoring. If you have a question, feel free to stop by, or contact us at subject_tutoring@roanoke.edu or 540-375-2590. See you soon!

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 Becky Harman, 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 Becky Harman at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Student Health & Counseling Services supports students through in-person health appointments, in-person counseling, 24/7 telehealth (TimelyCare), Therapy Assistance Online, as well as resources related to general wellness, LGBTQ+, sexual assault, substance abuse, and suicide prevention. Unmet health needs can negatively impact your performance in this course. Student Health & Counseling Services can help. Please see <https://www.roanoke.edu/shcs> for more information and to access services.

Date	Sections	Topics	Study Problems	
W 1/18	1.1	Feedback		
F 1/20	1.2,3	Functions, States	p23 #2	
M 1/23	1.4	Modeling Change	p43 #1,3,6,8,10	
W 1/25	1.5	Graphical	p53 #4	
F 1/27	1.6	Trajectories	p62 #2,3,4	QUIZ #1
M 1/30	2.2	Derivatives	p79 #1,2,3,5	
M 2/6	2.5	Deriv. Functions	p98 #1,4,5,6	
W 2/8		Epidemiology		QUIZ #2
F 2/10		COVID models	Project #1	
M 2/13	3.1,2	Equilibrium	p131 #2,3,4,7	
W 2/15	3.3,4	Three Dimensions	p147 #5,6,7	
W 2/17	3.5	Basins of Attraction	p155 #3,4,6	QUIZ #3
M 2/20	4.1	Oscillations	p181 #2,5,6	
W 2/22	5.1,2	Chaos	p238 #1,5.2.5	
F 2/24	5.5	Chaos in Nature		QUIZ #4
M 2/27		Introduction to R		
W 3/1		Project #2 Introduction		HW #1
F 3/3		PROJECT #1 DUE		
SPRING BREAK				
M 3/13		Hypothesis testing		
W 3/15		2-sample t-test		
F 3/17		Paired t-test		HW #2
M 3/20		ANOVA		
W 3/22		ANOVA		
F 3/24		Chi-square		HW #3
M 3/27		Chi-square		
W 3/29		Linear regression		
F 3/31		Logistic regression		HW #4
M 4/3		Transformations		
W 4/5		Correlation		
M 4/10		Hardy-Weinberg		
W 4/12		Mark and Recapture		
F 4/14		Multiple regression		HW #5
Week of 4/17		Project Group meetings		
T 4/25		PROJECT #2 Paper due		
Th 4/27		Exam 8:30-11:30		

Math 115 Information Sheet

Name:

Email:

Cell phone:

Major(s):

Hometown:

List the math/stat course(s) you took last year.

How hard do you expect Math 115 to be? How interesting?

Why is math important?

What are some of the co-curricular or other campus activities you would like to participate in this year?