Math 115 - Quantitative Biology

Block 3 Fall 2019

Instructor: Prof. Jan Minton   461 Trexler Hall

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Office Hours: By appointment: Monday & Wednesday 3:30-4:30 and Tuesday & Thursday 2:30-4:30
Make appointments online at **jminton.youcanbook.me**

Course Objective: 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.

Understand the concept of 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.

Make a connection to 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

Free on-line at **http://www.biostathandbook.com/**

Supplemental Handouts
Inquire course management system available through MyRoanoke
Calculator (not on cellphone)

Attendance Policy: Full attendance is expected. Simple attendance is not graded, but there is good reason to predict that poor attendance will lead to lower grades overall. As stated in the Academic Catalog, "Every student is accountable for all work missed because of class absence. Instructors, however, are under no obligation to make special arrangements for students who are absent." Also, anytime you come in late or leave during class you miss part of the course and you disrupt the educational experience for everyone else. Do this only in the case of emergency.

Overall Workload: In addition to the 3 hours of class time, you are expected to work outside of class for a minimum of 9 additional hours per week.

Homework: Regular homework (assigned virtually every class period) will be a mix of practice problems and reading questions. It is important that you do this work in a timely fashion so that you can monitor your own progress and be prepared for the next class. This work will not be a direct part of the course average calculation but your effort will be recorded as responses collected through Inquire and used to make borderline decisions on final course grades.

Research Articles: Students 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.

Tests: There will be three in-class written tests. Make-up tests will be given only under *very* extenuating circumstances that prohibit you from physically appearing in the classroom.

Case Study Explorations: Six case studies will be explored using various computer applications. These will be conducted during class with students working in assigned teams of two. Students missing class on these days will be permitted to complete the work independently but such work will not be accepted for grading after grades have been posted for that assignment.

Poster Session: Students will work in teams of 2 to address a biological topic through data analysis and mathematical modeling. Findings will be presented in a poster session during class on Wednesday, December 4. Detailed requirements for the poster will be covered in class.

Final Exam: The final exam time for this course will be 8:30- 11:30 on Tuesday, December 10.

Academic Integrity And Electronic Devices: The college policy is fully supported. Expectations regarding permissible resources and individual versus group work will be clearly specified for each graded assignment.

The use of any unauthorized electronic device during completion of in-class graded work is strictly prohibited. Cell phones are never permitted. **Any use of a non-approved device while completing in-class graded work will be considered a breach of academic integrity.**

Grading: Weights for the various components of the course and final course letter grade assignments are given below:

Research Articles	10%	A 93-100	B- 80-82	D+ 67-69
Tests	40%	A- 90-92	C+ 77-79	D 63-66
Case Study Explorations	20%	B+ 87-89	C 73-76	D- 60-62
Poster Project	15%	B 83-86	C- 70-72	F below 60
Final Exam	15%			

Be aware - The Inquire gradebook will be used for grade STORAGE only. Inquire will not be used to calculate your official course average. Any averages you might see in Inquire for this course should not be trusted.

Schedule: Tests: Fridays - September 20, October 11, November 15

Case Study Explorations: Fridays – September 6, 13   October 4, 25   November 1, 8
Research Article Assignments due: Fridays – September 27   November 22
Poster Session – Wednesday December 4
Final Exam – Tuesday, December 10 8:30-11:30

Day by Day Details provided on Inquire

IMPORTANT TO NOTE: Material, content, and scheduling are subject to change if deemed appropriate or necessary by the instructor.

Math 115 Topics

Discrete Models

Ecological Succession: Fixed total area with various classifications (examples: Grass/Shrubs/Trees or Wet/Dry)
Written description, flow diagram, equations, Transfer matrix
  Find step by step distribution
  Find equilibrium distribution

Population with distinct life stages (examples: Egg/Hopper/Adult, Calf/Yearling/Adult)
  Written description, equations, Leslie matrix
  Find step by step distribution
  Find long term growth rate
  Find long term population structure

Continuous Models

Exponentials and logs – review
Average rate of change (calculate) vs Instantaneous rate of change (conceptual, relate to on graph)
Growth Models based on rate of change:
  Single Population: Given the differential equation, students use known solution forms Multiple
  Populations that Interact: Students set up system of differential equations.

Working with Data

Continuation of INQ 240 topics: Linear Regression
       Hypothesis Testing – means, proportions, ANOVA, Chi Square
With added emphasis on: Test selection
      Assumptions
      Transformation of Data

Significance vs Importance
Common errors in sampling, analysis, and reporting

And More …

Hardy Weinberg Equilibrium Model
Mark and Recapture Method of Counting
Counting by Serial Dilution
Calculation competence: working with formulae, percent, ratios, unit conversion
Interpretation of Graphs
Mathematics related to Size