MCB 315: Quantitative Biology
Syllabus – Fall 2018
Tues, Thurs 9:30-10:45 in McClelland Park 102

Description of Course

Modern biology and medicine are being revolutionized by quantitative measurements and models. Key to this revolution is the integration of life sciences with mathematics, engineering, physics, and computer science. To prepare UA students to understand and contribute to modern quantitative biology, MCB 315 is a one-semester introductory course covering contemporary quantitative approaches to biology.

Course Prerequisites or Co-requisites

Prerequisite: Completion of calculus.

Instructor and Contact Information

Ryan Gutenkunst, PhD, rgutenk@email.arizona.edu
Office hour: Tuesdays 4:00 pm in Life Sciences South 325

Matthew Miller, mattmiller899@email.arizona.edu
Office hour: Wednesday 3:30 pm in McClelland Park 102

Course assignments and notes will be posted on D2L. You should check the site frequently. In particular, we will be using the Calendar extensively to track assignments.

Rather than emailing questions to Dr. Gutenkunst, please post them on D2L. If questions are asked over email that the rest of class can benefit from, I will post them to D2L and reply there.

Course Objectives and Expected Learning Outcomes

By the end of the semester, you should:

1. Know the key molecular concepts essential to the function and evolution of life.
2. Understand the application of quantitative analysis and modeling in modern biology.
3. Be able to apply simulations and statistical analyses to extract meaning from biological data.

In terms of Learning Outcomes for the MCB degree program (http://assessment.arizona.edu/sci/molecular/undergrad), this course focuses on applying analytical thinking to biological problems. In particular, this course will enhance your ability to understand and build models that generate testable hypotheses about biological processes and to apply quantitative strategies to analyze and understand biological processes. We will also touch on almost all content outcomes, as we explore the many applications of quantitative thinking to modern biology.

Required Texts or Readings

Required weekly readings will be posted on D2L. In addition, the recommended text for the course is **The Processes of Life** by Lawrence E. Hunter. This is a wonderfully concise (and very affordable) summary of modern molecular biology. It is available at the campus bookstore.

Required or Special Materials

A scientific calculator will be necessary for in-class exercises and exams.

We will be using Matlab to perform simulations and analyze data, both in class and for homework. The UofA has a site license for Matlab, so you can install it on your personal

computer. To do so, go to http://softwarelicense.arizona.edu/mathworks-matlab and follow the student download link.

For in-class work, you may use the lab computers or bring your own laptop.

Later in the semester, we will be using COPASI to simulate biochemical systems and to annotate models for the BioModels database. It is also free and open source. You can install it from http://www.copasi.org/Download.

Reading quizzes

After resolving any common questions, we will have a **short quiz on the readings each Tuesday**. To encourage interaction and peer-to-peer learning, you will first take the quiz individually and then in a small group. Your final score for each quiz will be based 1/2 on your individual quiz and 1/2 on the group quiz.

In class exercises

Much of our class time will be spent on in-class exercises, often working in groups. If you are unable to finish the exercise in class, it will be due the following week. I expect you to ensure all members of your group are following the work that is done. **If you complete an assignment early, I ask you to join another group that has not finished and help out.** Explaining your approach to others is an excellent way to learn material deeply.

Homework

Homework will be **assigned each Thursday and due the following Thursday**. We encourage you to work together and to discuss the homework assignments with your classmates. All submitted work, however, must be your own. Publications or online sources must be also cited.

Checkpoint quizzes

During the semester there will be two checkpoint quizzes to assess your understanding of the course material and prepare you for the comprehensive exam.

Comprehensive exam

On **November 13** there will be a comprehensive exam covering all material in the course to that point.

Final Examination or Project

There will be no final examination. The final project for the course will center on a model from BioModels (http://biomodels.net) and the accompanying scientific article. Working in groups, you will give a **15-minute presentation** to your classmates explaining the article and relevant background. Also as a group, you will also **curate the model** for deposition in BioModels. Models curated to sufficiently high quality will be added to the database, and you will be acknowledged as the curators. Working individually, you will also turn in a **5-8 page paper** summarizing the article, including background, methods, and results.

Grading Scale and Policies

Final scores for the course will be calculated as below, and letter grades will be assigned based on the rubric below. If necessary, the instructor may lower the curve to shift the grade distribution upward.

Homework	25%
Comprehensive exam	20%
Final project paper	15%
Final project presentation	10%
Final project curation	5%
In-class exercises	10%
Checkpoint quizzes	10%
Reading quizzes	5%

A	>85%
B	75-85%
C	65-75%
D	55-65%
E	<55%

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

Late work policy

Work less than one week late will have a **25% score reduction**. Work more than one week late will have a **50% score reduction**. These penalties can be waived with prior approval.

Absence and Class Participation Policy

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop. The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, http://policy.arizona.edu/human-resources/religious-accommodation-policy. Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: https://deanofstudents.arizona.edu/absences.

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all course meetings. Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Threatening Behavior Policy

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Accessibility and Accommodations

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268) to explore reasonable accommodation.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See:
http://deanofstudents.arizona.edu/codeofacademicintegrity
http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.

The University Libraries have some excellent tips for avoiding plagiarism, available at http://new.library.arizona.edu/research/citing/plagiarism.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

UA Nondiscrimination and Anti-harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Student Assistance and Advocacy information is available at
http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

Confidentiality of Student Records

http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa

Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

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Fall 2018

Week	Session	Date	Topic
1	1	Tue, Aug 21	Intro to course
	2	Thu, Aug 23	Estimation, units, log-scales, history of life on Earth
2	3	Tue, Aug 28	Functions on a log-scale
	4	Thu, Aug 30	Matlab tutorials
3	5	Tue, Sep 4	Counting sequences
	6	Thu, Sep 6	Mendelian genetics
4	7	Tue, Sep 11	Wright-Fisher neutral model - neutral
	8	Thu, Sep 13	Wright-Fisher model - selection
5	9	Tue, Sep 18	Exponential and Poisson distributions
	10	Thu, Sep 20	Molecular motors
6	11	Tue, Sep 25	Stochastic simulation with mass action kinetics
	12	Thu, Sep 27	Probability review
7	13	Tue, Oct 2	Cancer incidence statistics
	14	Thu, Oct 4	**Checkpoint quiz**
8	15	Tue, Oct 9	ODE simulation and HIV replication
	16	Thu, Oct 11	Transcription network modeling
9	17	Tue, Oct 16	The cell cycle
	18	Thu, Oct 18	Lateral Inhibition
10	19	Tue, Oct 23	Significance testing
	20	Thu, Oct 25	Genome-wide association / multiple testing
11	21	Tue, Oct 30	Epidemiological modeling
	22	Thu, Nov 1	**Checkpoint quiz**
12	23	Tue, Nov 6	Review for comprehensive exam (Prof. Gutenkunst away)
	24	Thu, Nov 8	HIV replication and mutation
13	25	Tue, Nov 13	**Comprehensive exam**
	26	Thu, Nov 15	BioModels curation and annotation + Choose final papers
14	27	Tue, Nov 20	Final paper work session
	28	Thu, Nov 22	**No class** - Thanksgiving break
15	29	Tue, Nov 27	Final paper work session
	30	Thu, Nov 29	Final paper work session
16	31	Tue, Dec 4	**Final presentations**
		Thu, Dec 6	
17		Tue, Dec 11	Final paper due
		Thu, Dec 13	**Last day to turn in late work**