

# MCB585: Multidisciplinary/Quantitative Approaches to Solving Biological Problems

## Fall 2021

### INSTRUCTORS:

George Sutphin  
Assistant Professor, Molecular & Cellular Biology  
[sutphin@arizona.edu](mailto:sutphin@arizona.edu)

Megha Padi  
Assistant Professor, Molecular & Cellular Biology  
[mpadi@arizona.edu](mailto:mpadi@arizona.edu)

Andrew Paek  
Assistant Professor, Molecular & Cellular Biology  
[apaek@arizona.edu](mailto:apaek@arizona.edu)

**Availability:** All three instructors are available by appointment for in-person or Zoom meetings. Please reach out!

### COURSE LOGISTICS:

Course Modality: In Person

Class Meetings: Tuesdays, Thursdays: 9:00 – 10:45 am

Location: LSS 240

Websites:

- D2L – we will use D2L for course announcements, sharing course documents, and collecting daily assignments and final projects.
- The first segment of the course will follow the material on this website:  
<https://georgesutphin.github.io/MCB585/>

Course Recordings: For lecture recordings, which are used at the discretion of the instructor, students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with [UArizona values](#) and educational policies ([Code of Academic Integrity](#) and the [Student Code of Conduct](#)) are also subject to civil action.

Our in-person meetings will give us the opportunity to discuss critical topics and demonstrate programming and analysis techniques. You are required to complete assignments and projects on your own time to demonstrate mastery of the concepts presented in the course.

## **COURSE CONTENT:**

MCB585 is an advanced graduate course focused on quantitative approaches to biological questions. Students will learn how to acquire, access, and interact with large biological datasets. The course relies heavily on learning and utilizing the R Statistical Programming language and Matlab, but students are not expected to have programming experience upon entering the course. The course is broken up into three units. The first unit will focus on introducing R and using R in basic statistical operations. This section incorporates elements of experimental design and appropriate application of statistical tests as a frame for learning R. In the second unit we will focus on analyzing genomic and high-throughput data with an introduction to machine learning and data integration. The third section focuses on extracting quantitative information from image data in Matlab and applying the statistical tools from the first section on this data.

## **COURSE GOALS:**

Students will be able to:

1. Use the R programming environment to approach basic problems in biological sciences.
2. Apply basic biostatistics methods, such as selecting and employing an appropriate statistical test and conducting a power analysis based on preliminary data.
3. Access, manipulate, and analyze large biological datasets.
4. Perform RNA-sequencing analysis starting from raw reads all the way to differential expression and pathway analysis.
5. Understand how statistical computing approaches can be used to integrate and visualize multi-'omics data.
6. Perform background subtraction, segment, and extract quantitative information from imaging data using MATLAB and Cell Profiler.

## **REGISTRATION AND PREREQUISITES:**

MCB585 is an advanced course intended for second-year graduate students. The prerequisites for the course are:

1. One year of graduate-level coursework.
2. Two core courses required for the MCB, BIOC or CMM PhD.

## **COURSE REQUIREMENTS:**

1. Attend class meetings.
2. Participate in discussions and in-class exercises.
3. Read assignments, completed before class.
4. Complete computer exercises before and during class. Code for offline exercises should be submitted prior to the start of class.
5. Complete the *Proposal* and *Presentation* for the Final Project: Analyzing a Large Dataset.
  - a. Proposal: Students will submit a ½ page proposal for a final project that employs the tools and concepts covered in the course to analyze a large dataset. The

dataset can come from a published study or from the students own research. Students can choose to either (1) reproduce a result found in a paper to demonstrate rigor of published statistical methods, or (2) extract a novel finding from their selected dataset. Proposals will be due early in the final third of the semester and reviewed by the course instructors. The instructors may request a discussion to clarify key details or suggest alternative approaches. Proposals can be revised later in the semester with approval.

- b. Presentations: Students will deliver a 15 minute presentation on the background, methodology, and results from their selected project. A short (~1 page text plus figures) written report on findings including the code used to generate results must be submitted for review prior to the final presentation.

### **GRADING SUMMARY:**

34% attendance and participation in exercises and discussion

33% completion of assignments.

33% student research final project proposals, report (including code), and presentation

### **ATTENDANCE:**

- If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructor(s) if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does **not** guarantee an automatic extension of due date or rescheduling of examinations/assessments.
  - Please communicate and coordinate any request directly with your instructor.
  - If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office [DOS-deanofstudents@email.arizona.edu](mailto:DOS-deanofstudents@email.arizona.edu) to share documentation about the challenges you are facing.
- Voluntary, free, and convenient [COVID-19 testing](#) is available for students on Main Campus.
- If you test positive for COVID-19 and you are participating in on-campus activities, you must report your results to Campus Health. To learn more about the process for reporting a positive test, visit the [Case Notification Protocol](#).
- COVID-19 vaccine is available for all students at [Campus Health](#).

*Statement on compliance with the COVID-19 mitigation guidelines:* As we enter the Fall semester, the health and wellbeing of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit [www.covid19.arizona.edu](http://www.covid19.arizona.edu) for the latest guidance.

## EQUIPMENT AND SOFTWARE REQUIREMENTS:

For this class you will need daily access to the following hardware and software:

- Laptop or web-enabled device capable of running the software listed below
- Regular access to reliable internet signal

You will also need the ability to download and run the following software:

- R Statistical Programming Language (<https://cloud.r-project.org/>)
- RStudio (<https://rstudio.com/products/rstudio/>)
- MATLAB (<https://www.mathworks.com/academia/tah-portal/university-of-arizona-30356115.html>)
- Cell Profiler (<https://cellprofiler.org/>)

## EXPECTATIONS FOR STUDENT BEHAVIOR:

**Academic integrity.** We refer you to the guidelines set forth by the University regarding academic honesty as a general overview of our expectations for MCB 585:

<https://deanofstudents.arizona.edu/student-rights-responsibilities/academic-integrity>

Expectations specific to MCB 585: Students are encouraged to work together on the critical thinking exercises, but out-of-class assignments must be completed by each student individually (students may advise their partner on the final presentation).

**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>.

**Nondiscrimination and anti-harassment policy.** The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see: <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>.

In addition, the use of cell phones and computers for activities outside of coursework are prohibited during class meetings.

## ACADEMIC ADVISING:

If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to [advising@arizona.edu](mailto:advising@arizona.edu)

**LIFE CHALLENGES:**

If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office can be reached at (520) 621-2057 or DOS-deanofstudents@email.arizona.edu.

**PHYSICAL AND MENTAL-HEALTH CHALLENGES:**

If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520) 621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

**UNIVERSITY POLICIES**

For up-to-date information on university policies related to course syllabi, please see: <https://academicaffairs.arizona.edu/syllabus-policies>

**SUBJECT TO CHANGE NOTICE:**

The information contained in this course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructors of this course.