# PGY630: Quantitative methods for biomedical research (2 credit hours)

Wednesday mornings, 9-11 am, MS505

## Faculty

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Kenneth S. Campbell, PhD | Course Director | MN510 UKMC | 859-323-8157 | [k.s.campbell@uky.edu](mailto:k.s.campbell@uky.edu) |

## Office Hours

Dr. Campbell is available for questions or concerns as needed. The best first step is to speak to him during class-time. Follow-up by email as required.

## Canvas

Information will be provided via the PGY630 site on Canvas (<https://uk.instructure.com/courses/2033529>). The Canvas system will also be used to send emails to the class. Please make sure that your contact details on Canvas are up to date.

To resolve technical difficulties with Canvas, please contact UK Information Technology (<http://www.uky.edu/ukit>, 859-218-HELP, or [helpdesk@uky.edu](mailto:helpdesk@uky.edu)).

## Course description

“*Quantitative methods for biomedical research*” is a 2 credit graduate-level class designed for PhD students and others who wish to develop skills relating to data analysis and interpretation. The course will include sections on data handling, plotting, statistics, and image analysis. Students will be shown how to automate routine analysis tasks and encouraged to develop quantitative skills that will help them to solve future problems by themselves. The course will use MATLAB software but the techniques and content are relevant to all types of scientific programming. Students will also be introduced to GitHub and shown how to organize code and data to improve rigor and reproducibility.

Classes will typically consist of one-hour of didactic instruction and/or tutorials followed by a second hour of hands-on practical experience. Videos may be posted before some classes to allow for a ‘flipped-classroom’ style of teaching.

## Required materials

All lecture material will be published at <https://campbell-muscle-lab.github.io/teaching_PGY630_QM/>

## Associated expenses

Not applicable

## Skill / technology requirements

Students will be accepted at the discretion of the Course Director.

Students will need access to MATLAB software throughout the semester. Most students will find it helpful to have MATLAB installed on a laptop that they bring to class.

Information on installing the University of Kentucky’s MATLAB instance is at  
<http://www.uky.edu/its/sites/www.uky.edu.its/files/TAH_quickstart_guide.pdf>

## Additional points

* Install MATLAB on your laptop before you come to the first class.
* Individuals who have not previously used MATLAB software should complete the MATLAB Onramp (available at <https://matlabacademy.mathworks.com/>) before the first class.  
  **NOTE THAT THERE ABOUT 3 HOURS OF VIDEOS. DEPENDING ON YOUR EXPERIENCE, IT MAY TAKE YOU LONGER THAN THIS TO COMPLETE THE TRAINING.**

## Student learning outcomes

At the end of this course, a student should be able to use MATLAB or similar software to:

* Import experimental data from text files, spread-sheets, images, and movies
* Plot data in appropriate formats (including bar charts, scatter plots, surface plots)
* Fit models to data (including straight lines, polynomials, and exponentials)
* Perform and interpret hypothesis tests (including t-tests and ANOVA)
* Segment images to detect features
* Extract statistics about image features (including areas, colors, and eccentricities)
* Analyze gels and immunoblots

## Course activities

The course will use a mixture of didactic approaches, in-person tutorials, and self-paced learning activities. Students will be asked to submit brief assignments each week.

## Grading

Students will be able to accumulate a maximum of 100 points as follows:

|  |  |  |
| --- | --- | --- |
| Component | Points | Grading criteria |
| Mid-term project | 20 | Student:   * attempts an appropriate problem * demonstrates problem-solving skills * documents limitations of approach |
| Final project | 20 | Student:   * attempts an appropriate problem * demonstrates problem-solving skills * documents limitations of approach |
| Weekly assignments | 28 (2 per assignment) | Student:   * makes a significant attempt to complete the task |
| Class discussion | 32 (2 per class) | Student:   * is engaged throughout the class period * asks questions and participates in discussions |

## Submission details and deadlines

All assignments should be uploaded to Canvas as a single PDF file. You may wish to make this file using PowerPoint but you can also publish code from MATLAB (<https://www.mathworks.com/help/matlab/matlab_prog/publishing-matlab-code.html>).

* Weekly assignments, noon on Tuesdays
* Mid-term projects, noon on Tuesday, 8 March
* Final projects, noon on Tuesday, 3 May

## Return of assignments

Grading will be performed using Canvas

## Grading scale

Grades will allocated as follows:

* A: 90 to 100 points
* B: 80 to 89 points
* C: 70 to 79 points
* D: 60-69 points
* E: 59 points or lower

Midterm grades will be assigned to each student.

## Submission of late assignments and late policies

Assignments that are submitted after the deadline may not receive credit.

## Course activities outside of regularly scheduled classes

Not applicable.

## Academic policies

<https://www.uky.edu/universitysenate/acadpolicy>

## Attendance policies

* Attendance is mandatory. Students who miss 20% or more of classes may be asked to withdraw from the class.
* Students without excused absences will be given zero points for class discussion / presentation
* Students without excused absences who do not submit weekly assignments on time will be given zero points for their assignments
* Students with excused absences will be given make-up opportunities

## Verification of Absences

Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request “appropriate verification” when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

For an excused absence for illness, a Tier 2 or Tier 3 document provided to the student by UHS is appropriate verification.

## Disabilities and Medical Conditions

A student with a documented disability that requires academic accommodations for this course must make a request to the University Disability Resource Center. When accommodations are approved, the Center will provide the course director with a Letter of Accommodation that details the recommended accommodations from the Disability Resource Center. In order to receive the recommended accommodations, the student must provide the Course Director with an official letter from the Disability Resource Center at least 10 days before the assessment is due.

More information about the Disability Resource Center is available at <https://www.uky.edu/DisabilityResourceCenter/>

## Class Behavior, Decorum and Civility

Students are expected to maintain a level of dignity and respect towards faculty, staff, and fellow students. Students are expected to value differences among all members of our academic community. Conversely, all students have the right to take reasoned exception and voice opinions contrary to those offered by the instructor and/or other students according to University Senate Rules. Equally, a faculty member has the right and the responsibility to ensure that all academic discourse occurs in a context characterized by respect and civility. Acceptable decorum and civility does not include attacks of a personal nature or statements denigrating another on the basis of race, sex, religion, sexual orientation, age, or national/regional origin.

## Academic Integrity

Per university policy, students shall not plagiarize, cheat, falsify, or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed. Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at <http://www.uky.edu/Ombud>. A plea of ignorance is not acceptable as a defense against the charge of dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

## Statement on diversity, equity, and inclusion

The University of Kentucky is committed to our core values of diversity and inclusion, mutual respect and human dignity, and a sense of community ([Governing Regulations XIV](https://www.uky.edu/regs/gr14)). We acknowledge and respect the seen and unseen diverse identities and experiences of all members of the university community (<https://www.uky.edu/regs/gr14>). These identities include but are not limited to those based on race, ethnicity, gender identity and expressions, ideas and perspectives, religious and cultural beliefs, sexual orientation, national origin, age, ability, and socioeconomic status. We are committed to equity and justice and providing a learning and engaging community in which every member is engaged, heard, and valued.

We strive to rectify and change behavior that is inconsistent with our principles and commitment to diversity, equity, and inclusion. If students encounter such behavior in a course, they are encouraged to speak with the instructor of record and/or the [Office of Institutional Equity and Equal Opportunity](https://www.uky.edu/eeo/). Students may also contact a faculty member within the department, program director, the director of undergraduate or graduate studies, the department chair, any college administrator, or the dean. All of these individuals are mandatory reporters under University policies.

## Lesson plan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***General area*** | ***Week*** | ***Date (all 2022)*** | ***Topic*** | ***Additional details*** |
| Introduction | 1 | 12 Jan | Introduction to the class | Setting goals for the class, introduction to GitHub |
| Basics | 2 | 19 Jan | Working with data | Reading and writing data files, tables, filtering and sorting |
|  | 3 | 26 Jan | Batch processing | Organizing projects, batch processing |
|  | 4 | 2 Feb | Plotting | Bar charts, scatter plots, jitter plots |
| Curve fitting | 5 | 9 Feb | Linear regression | Fitting a straight line to data, Interpretation of p value and r |
|  | 6 | 16 Feb | Non-linear regression | Fitting curves to data |
| Statistics | 7 | 23 Feb | Statistics 1 | t-tests |
|  | 8 | 2 Mar | Statistics 2 | ANOVA |
|  | 9 | 9 Mar | Review of mid-term project | Discussion of mid-term project |
| Image processing | 10 | 23 Mar | Image basics | Bit resolution, color spaces, image formats |
|  | 11 | 30 Mar | Image handling | Resizing, cropping, brightness and contrast |
|  | 12 | 6 Apr | Segmentation | Thresholding |
|  | 13 | 13 Apr | Binary image analysis | Shape statistics |
|  | 14 | 20 Apr | Gels and immunoblots | Densitometry profiles, background correction |
|  | 15 | 27 Apr | Movies | Reviewing of image formats, tracking objects |
|  | 16 | 4 May | Review | Discussion of final projects |