LS 40: Statistics of Biological Systems

Course Description:
Designed for life sciences students. Introduction to statistics, with emphasis on computer simulation of chance probabilities as a replacement for the traditional formula-based approach. Simulations allow for deeper understanding of statistical concepts and are applicable to a wider class of distributions and estimators. We will be using the programming language Python (on which Sage is based) to carry out statistical simulations and apply them to analyzing biological data while gaining understanding of probability, distributions, confidence intervals, hypothesis testing, statistical independence, linear regression, multiple-group comparisons, and statistical power. Students will learn to visualize, analyze and communicate results of biological data through hands-on practice in the computational laboratory. Prerequisite: LS 30A. Lecture: 2 X 1.25 hrs/wk. Laboratory: 2 hrs/wk (combination of discussion and data analysis labs)

Instructor: Alan Garfinkel (Dept. of Medicine (Cardiology) and Department of Integrative Biology and Physiology). Office: 1121 Terasaki Life Sciences. Extension 6-8651 (= (310) 206-8651 outside UCLA). Email: agarfinkel@mednet.ucla.edu. Office hours TW 1:30 – 3.

Administrative Coordinator: Kristin McCully (kmccully@ucla.edu). Handles administrative issues, grading, issues with websites, etc.

Instructional Team:
- Jane Shevtsov (lab director and LA coordinator)
- Kendall Islam (undergraduate advisor)

For enrollment questions, you may contact the Life Science Core Education Office by email (lscore@lifesci.ucla.edu).

Teaching Assistants:

<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
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<tbody>
<tr>
<td>Vennis Hong</td>
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Learning Assistants:

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Danah Albaaj</td>
<td>Steven Liu</td>
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<tr>
<td>Lauren Bui</td>
<td>Dilagsayini Mylvaganam</td>
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<tr>
<td>Angel Cortez</td>
<td>Jet Talandis</td>
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<tr>
<td>Gabriel Angel Garcia</td>
<td>Angelina Vargas</td>
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<tr>
<td>Gabriela F Gutierrez</td>
<td>Mindy Zhang</td>
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Course Website: [https://ccle.ucla.edu/course/view/19S-LIFESCI40-1](https://ccle.ucla.edu/course/view/19S-LIFESCI40-1)

Topics, by Week [Tentative]:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to course. Need for this course: the current crisis of irreproducible experiments and unreliable conclusions. Exploring, visualizing, and describing data.</td>
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<tr>
<td>2</td>
<td>Concept of probability. Simulating chance probabilities. Calculating p-values. The concept of the &quot;Null Hypothesis&quot;. Problems with Null Hypothesis significance testing. Presenting data as “effect size and confidence interval”.</td>
</tr>
<tr>
<td>4</td>
<td>Comparing two groups: Two Box method, Big Box method. Dealing with small N: rank-based tests. Theoretical approaches to two groups: the “t-test”.</td>
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<tr>
<td>5</td>
<td>Paired data. Theoretical approaches to two groups: the “t-test”. Problems of multiple testing. Three or more groups: one-way ANOVA.</td>
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<td><strong>MIDTERM May 6</strong></td>
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<tr>
<td>7</td>
<td>Regression. Ordinary least squares linear regression: how to do it, problems and pitfalls. Confidence intervals for the regression slope and intercept.</td>
</tr>
<tr>
<td>8</td>
<td>Proportions. 2 X 2 outcome tables. Chi-squared test and measures of independence. Fisher’s exact test and its simulation. Statistical power. The importance of power in positive and negative findings.</td>
</tr>
<tr>
<td>9</td>
<td>Calculating power by simulation methods. Factors that affect power. Bayesianism. Concept of predictive power.</td>
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<td><strong>FINAL June 14</strong></td>
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Grading:
Your final grade in this class will be automatically computed as the maximum of the following two schemes:

<table>
<thead>
<tr>
<th>Scheme 1</th>
<th>Scheme 2</th>
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<tbody>
<tr>
<td>Assignments: 22%</td>
<td>Assignments: 22%</td>
</tr>
<tr>
<td>Lab exam: 5%</td>
<td>Lab exam: 5%</td>
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<tr>
<td>Midterm: 20%</td>
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<tr>
<td>Final exam: 50%</td>
<td>Final exam: 70%</td>
</tr>
<tr>
<td>Participation: 3%</td>
<td>Participation: 3%</td>
</tr>
</tbody>
</table>

This course is not “graded on a curve” (that is, not graded competitively). If you do well and earn >90% on course assignments, you will earn at least an A-! Collaboration is encouraged and sometimes required! You are guaranteed an A- if >90%, a B- if >80% and a C- if >70%. More information is provided below for specific assignments and in the Course Grading section from Life Sciences Core.

We will drop the two lowest clicker scores and one lowest assignment automatically when we calculate each grading scheme.

Piazza Discussion Forum
http://piazza.com/ucla/spring2019/ls40/
Non-urgent announcements and class content discussion will take place on Piazza, a tool to help organize these conversations. Rather than emailing questions to the teaching staff, we encourage you to post your questions on Piazza. Please click the above link and follow the instructions to join this course’s forum.

Readings: Chapters from a textbook Dr. Garfinkel is writing and other articles are provided on CCLE site. You are expected to do these readings before the corresponding lecture.

Active Learning: Throughout the course, we will have “active learning” exercises such as clicker questions to help you strengthen your understanding. You will have to answer at least 75% of clicker questions in each class session to receive credit for that session. Effort in these exercises will be included in the Participation component of your course grade. You will need to use an iClicker in all lecture sessions starting on Thursday of Week 1 (any type of iClicker will work) and register it on our CCLE site.

Programming: Throughout this course, we will be using the programming language Python (which Sage is based on) to explore the statistical concepts we develop. We will be using Jupyter notebooks on the CoCalc platform that you used in LS 30A. Each week, you will attend a two-hour lab session, which will be a combination of discussion section and using programming to explore course content. Any work that you do not complete in lab and any additional writing up that you need to do before turning it in can be done at home or during open hours in the NSLC computer labs or other computer labs. The only programming experience assumed is LS 30A.
Assignments: Assignments will often use programming and will generally be automatically collected online about one week after they are assigned (i.e. typically Wednesday 8 am). Scores will be based on a combination of effort (completion) and accuracy. Shorter assignments may be given as necessary.

Attendance in your enrolled section is mandatory. If you do not participate in at least ¾ of the section (and do not have an excused absence explained to your TA), we will deduct 10% from your assignment score for that week.

Exams: There will be one midterm, a lab exam, and a final exam. You are strongly advised to bring a calculator to the midterm and final exams; however, it may not be a graphing calculator, nor any device capable of communicating with another device (such as a cell phone or tablet). A basic four-function calculator may suffice, but you might prefer a non-graphing scientific calculator. (You will also probably find this useful for exams in your chemistry and physics classes.) No notes or books may be used during the exam.

The lab exam will be in your week 10 section and include analyzing data with Python.

If you might not be able to take an exam, fill out the Google form LS Core will distribute via a CCLE announcement in the first two weeks of class and we will determine whether to schedule a make-up exam. By University rules, you must take the final exam in order to pass the class. Make-ups for the final exam are permitted only under exceptional circumstances, as outlined in the UCLA student handbook. Please bring a photo ID to each exam. The exams are scheduled for the following dates:

- **Midterm:** Monday, May 6, 6:00-7:50 PM
- **Final Exam:** Friday, June 14, 11:30 AM – 2:30 PM

Note that the midterm is scheduled in the evening, outside of class. Please make sure that your schedule is clear on that day at that time! The location of exams will be announced later.

Use of Laptops, Tablets or Phones in Class: We like technology, but there is now ample research showing that taking notes electronically is much less beneficial than doing so by hand. (It also doesn’t work well in a class where we will use diagrams and mathematical notation a lot.) In addition to the ever-present temptation to go on Facebook, laptops make it easy to type down everything the instructor says instead of summarizing it, but looking for key points and summarizing are some of the most important benefits of taking notes. They also distract other students. Therefore, the use of laptops, tablets, or phones is not allowed in class, with the following exceptions:

1. You are hand-writing notes (not typing) on an electronic device. Keep in mind that you still have the temptation to distract yourself and others.
2. You have a documented disability for which taking notes on a computer is an accommodation. Please see the section on disability accommodations.
3. You have truly illegible handwriting. Please show Kristin a sample of said
handwriting by the end of Week 1.

4. You are aware of the downsides of computer use in the classroom but make an informed decision to do so anyway. To take advantage of this exception, please give Kristin a one-page (typed or handwritten) write-up on the downsides of computer use in the classroom by the end of Week 1. The following articles (on the next page) can get you started:

- “Students are Better Off without a Laptop in the Classroom”. Scientific American.
- Willingham, D. “New Studies Show the Cost of Laptop Use in Lecture Classes”.

**Grading with Gradescope:**
We will be using an online platform called Gradescope (gradescope.com) to score your assignments (including exams). This platform streamlines the grading process in large-enrollment courses for assignments with open-response questions, allowing for more consistent and fair grading. The points breakdown for the score you receive on an assignment graded using Gradescope will be transparent because you will be able to see the comments explaining what you did correctly or incorrectly in connection with the points (sometimes awarded as partial credit) assigned for a given question.

All exams are scanned and uploaded to the Gradescope website by your instructor(s) or TA(s). You (the student) may be responsible for uploading other assignments. Your instructors and TAs (or Readers) will access your responses and score them online. Graded exams and assignments will be returned to you electronically via Gradescope.

Using this platform for feedback on your assignments is optional. If you would prefer that your assignments not be uploaded to Gradescope, then your answers instead will be scored by hand and returned to you to view as a hard copy (on paper). This process will take substantially longer and provide less detailed feedback.

To comply with FERPA guidelines, please complete the Permission to Release Education Record Form on CCLE indicating whether or not you will allow us to score your class assignment and exams using Gradescope. For information about Gradescope’s privacy policy, please see https://gradescope.com/privacy.

If you opt in to using Gradescope, you will receive an email from Gradescope sometime around the time of the first exam. Materials uploaded to Gradescope will contain your name, UCLA email address, and the last 6 digits of your student ID number as well as your responses to questions on class assignments (including exams). Feedback in the form of numerical scores and written comments will be stored on the site and returned to you electronically with notifications given via the email address associated with your Gradescope account.

**Additional Information.** Please read the following notices, which are included in this syllabus to incorporate Life Science Core and UCLA policies.
UCLA Life Sciences Core Education

IMPORTANT NOTICES

Academic Integrity - A Bruin's Code of Conduct

UCLA is a community of scholars committed to the values of integrity. In this community, all members including faculty, staff, and students alike are responsible for maintaining the highest standards of academic honesty and quality of academic work. As a student and member of the UCLA community, you are expected to demonstrate integrity in all of your academic endeavors. When accusations of academic dishonesty occur, the Office of the Dean of Students investigates and adjudicates suspected violations of this student code. Unacceptable behaviors include cheating, fabrication, plagiarism, multiple submissions without instructor permission, using unauthorized study aids, or facilitating academic misconduct.

Please review our campus’ policy on academic integrity in the UCLA Student Conduct Code: [http://www.deanofstudents.ucla.edu/Student-Conduct-Code](http://www.deanofstudents.ucla.edu/Student-Conduct-Code).

Once referred to the Office of the Dean of Students, allegations of academic dishonesty can lead to formal disciplinary proceedings. Being found responsible for violations of academic integrity can result in disciplinary actions such as the loss of course credit for an entire term, suspension for several terms, or dismissal from the University. Such negative marks on your academic record may become a major obstacle to admission to graduate, medical, or professional school.

We cannot make exceptions to our campus’ policy on academic integrity, and as we hopefully have communicated effectively here, penalties for violations of this policy are harsh. Please do not believe it if you hear that “everyone does it”. The truth is, you usually don’t hear about imposed disciplinary actions because they are kept confidential. So our advice, just don’t do it! Let’s embrace what it means to be a true Bruin and together be committed to the values of integrity.

**Examples of academic dishonesty possible in LS Core courses:**

With respect to our course, examples of academic dishonesty include giving answers on assignments to someone else, receiving answers from someone else, turning in any written work that is not your own for points in our course, copying passages from websites, copying passages from your or any other textbook on any graded material in the course, or bringing a classmate’s clicker to class to get participation points for them when they are absent. If you engage in these types of unacceptable behaviors, then you will receive a zero as your score for that assignment. If you are caught cheating on an exam (e.g., using notes, using cell phones or other smart devices to send, receive, or research an answer, looking on someone else’s exam, allowing someone else to look at your exam for answers), then you will receive a score of zero for the entire exam.
**Exams:** No cell phones, smart watches, or similar types of devices are allowed during exams. Accordingly, you may not use cell phones as a clock to keep time or as a calculator. Please leave these items in your backpack and turned off or submitted to a TA/exam proctor. Be prepared to leave your backpacks and personal items (including hats) at the front of the room when taking your exams.

**Enrollment:**
In the event that we are at maximum enrollment capacity and you would like to enroll in this course, please monitor the Schedule of Classes in case someone drops the course. If you have other enrollment concerns, please go to the LS Core office in 222 Hershey Hall where you can talk to a Student Affairs Officers (SAOs) for the Life Science Core Education Department. **We and the SAOs are unable to provide students permission to enroll (PTE) numbers.**

**Changing Discussion/Lab Sections:**
Participation in discussion and lab sections is required for this course, and you must attend the section in which you are enrolled.

Please note that you are not permitted to switch enrollment in discussion/lab sections after the first week of the quarter. If you would like to switch sections during the first week but there are no spots available in the desired section, you need to find another student who agrees to switch sections with you. To make the switch in discussion/lab sections official with the registrar, you both will need to go to the LS Core office in 222 Hershey Hall and discuss your intention to switch sections in person.

**Absences in Discussion/Lab Sections (including required documentation policy):**
If there is an extenuating circumstance and you miss a discussion/lab section, please provide verifiable documentation to the LS Core office (within 7 days of your absence) to explain your absence, the basis of which is subject to their approval.

**Absences in Lecture or Exams (including required documentation policy):**
If you miss a lecture or exam, please provide verifiable documentation to the LS Core office (within 7 days of your absence) to explain your absence, the basis of which is subject to their approval.
Our Inclusive Learning Environment

UCLA values diversity and inclusion. We expect everyone in this class to contribute to a respectful, welcoming, and inclusive environment to support the learning of all other members of the class. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify us.

Students needing academic accommodations based on a disability should contact the Center for Accessible Education (CAE) at (310) 825-1501 or present in person at Murphy Hall A255. CAE will assess all requested accommodations and communicate appropriately with us (your instructors). Any students with CAE approval for proctoring arrangements during exams will need to please inform us (or your TA) prior to the date of the exam. When possible, students should contact CAE within the first two weeks of the quarter to allow reasonable time to coordinate accommodations. For more information, please visit the CAE website: http://www.cae.ucla.edu.

Resources are available to foster the well-being of all UCLA students as they pursue their academic goals. Any student who finds themselves in immediate distress, please call Counseling and Psychological Services (CAPS) to speak directly with a counselor 24/7 at (310) 825-0768, or please call 911. For more information, please visit the CAPS website: http://www.counseling.ucla.edu.
We are committed to making sure the assessment of your learning in this course is comprehensive, fair, and equitable. Your grade in this class will be based on the number of points you earn out of the total number of points possible and is not based on your rank relative to other students. Furthermore, grades are assigned without strict limits on the proportion of each letter grade given in the course.

If and when, for any reason, you have concerns about your grade in the course, please come and speak with us or your TA so that we can discuss study techniques or alternative strategies to help you.

Regrading policy:
Any request for a regrade must be made within one week of the assignment being returned to you. If you think there has been a simple addition error on your assignment then write a note explaining the error, attach this to the front of the assignment and turn it into your TA. If the error is confirmed, then the points will be added to your score before the end of the quarter. In the event that you do turn in a regrade, you should make a photocopy for your own records. All regrades (except addition errors) will be done by the end of the quarter after we have calculated final grades. If the points you request will affect your final grade, then we will reevaluate the assignment for the contested points. You will be able to request regrades for exams via Gradescope.

Please protect the integrity of all course materials and content. By enrolling in this course, you agree to honor this request. Be mindful of the hard work and time that our instructors and TAs in the LS Core put into creating course materials such as exam and quiz questions, worksheets, lecture videos, and Bruincasts. Please do not upload course materials not created by you onto third-party websites or share content with anyone who is not enrolled in our course. We are grateful for your cooperation in honoring this important request.
UCLA has a multitude of resources available to all students. Many of these resources are listed below (alphabetized by name), and we encourage students to explore them as needed.

- **Academic Advancement Program (AAP):** This program advocates and facilitates the access, academic success, and graduation of students who have been historically underrepresented in higher education; informs and prepares students for graduate and professional schools; and develops the academic, scientific, political, economic, and community leadership necessary to transform society: [https://www.aap.ucla.edu](https://www.aap.ucla.edu)

- **Academics in the UCLA Residential Community:** Free workshops on a wide variety of issues relating to academic & personal success; (310) 825-9315; [https://reslife.ucla.edu](https://reslife.ucla.edu) (click on "academics")

- **Bruin Resource Center:** Includes services for transfer students, undocumented students, veterans, and students with dependents; [http://www.brc.ucla.edu](http://www.brc.ucla.edu).

- **Career Center:** Don’t wait until your senior year – visit the career center today! [http://www.career.ucla.edu](http://www.career.ucla.edu)

- **Center for Accessible Education (Formerly Office for Students with Disabilities):** Located in A255 Murphy Hall; (310) 825-1501, TDD (310) 206-6083; [http://www.cae.ucla.edu](http://www.cae.ucla.edu).

- **Counseling and Psychological Services (CAP):** Located in Wooden Center West; students in distress may call to speak directly with a counselor 24/7 at (310) 825-0768, or may call 911; [http://www.counseling.ucla.edu](http://www.counseling.ucla.edu)
  - Commonly known as the “Red Folder”, this tool is intended to provide you with quick access to important resources for assisting students in distress (see, say, do): [https://ceils.ucla.edu/wp-content/uploads/sites/2/2016/08/911Guide.pdf](https://ceils.ucla.edu/wp-content/uploads/sites/2/2016/08/911Guide.pdf)

- **Dashew Center for International Students and Scholars:** Located in 106 Bradley Hall; (310) 825-1681; [http://www.internationalcenter.ucla.edu](http://www.internationalcenter.ucla.edu)

- **Dean of Students Office:** General resource for all Bruins. Learn about academic integrity issues and your first amendment rights. Get help if you’ve experienced rape or sexual assault. Report a bias incident, and much more. Located in 1206 Murphy Hall; (310) 825-3871; [http://www.deanofstudents.ucla.edu](http://www.deanofstudents.ucla.edu)

- **Lesbian, Gay, Bisexual and Transgender Resource Center:** Located in the Student Activities Center, B36; (310) 206-3628; [http://www.lgbt.ucla.edu](http://www.lgbt.ucla.edu)

- **Letters & Science Academic Counseling Service:** Located in A316 Murphy Hall; (310) 825-1965; [http://cac.ucla.edu](http://cac.ucla.edu).

- **Library:** Get help with your research, find study spaces, attend a workshop, rent a laptop, and more. Learn more at [http://www.library.ucla.edu](http://www.library.ucla.edu).

- **Student Legal Services:** Located in A239 Murphy Hall; (310) 825-9894; [http://www.studentlegal.ucla.edu](http://www.studentlegal.ucla.edu)

- **Undergraduate Writing Center:** Peer learning facilitators (PLFs) are undergraduates who understand the challenges of writing at UCLA. Scheduled appointment and walk-in options are available, see [http://wp.ucla.edu/wc](http://wp.ucla.edu/wc) for more information and to get assistance with your writing.

- **UCLA ONE:** This website ([https://uclaone.com/](https://uclaone.com/)) serves as UCLA’s interactive, online gateway for mentorship, professional networking, peer driven career advice, and exclusive job leads. (Similar to LinkedIn but for the UCLA community).