



Syllabus

BIOS 645: Principles of Experimental Analysis
Spring 2022
3 Credits

Course Description

Continuation of Biostatistics 600; the analysis of experimental and observational data, including multiple regression, and analysis of variance and covariance. Previously offered as BIOS 545.

Prerequisites:

BIOS 600, 500H, or permission of the instructor are required. For MPH students with a concentration in Public Health Data Science, this is a required course, and the prerequisite is BIOS 550. In addition, it is highly recommended that students have taken BIOS 511 or completed a SAS Boot Camp prior to this course, as computing will be done primarily in SAS. Students are expected to know algebra and basic concepts of probability and statistics, including sample, population, and descriptive statistics; estimation and sampling distributions; Normal, F, t, and chi-squared distributions; hypothesis testing and confidence intervals.

Instructor

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Teaching Assistant: Quan Sun, quansun@live.unc.edu

Office Hours: There are no set office hours for this course. I often meet with students informally after class. I am happy to meet students at other times and places as needed, just request an appointment by email.

Course Website: <https://sakai.unc.edu/welcome/>, use your ONYEN and password.

Class Days, Times, Location:

Lecture: Tuesdays and Thursdays, 12:30 – 1:45 pm, Hooker 0001
Optional lab: Wednesdays 3:35 – 4:35 pm, McGavran-Greenberg 2308
(Zoom remains a possibility, but I hope to avoid it if I can)

Course Overview

This course provides an introduction to the analysis of experimental and observational data, focusing on multiple regression, ANOVA, and ANCOVA. It is required for MPH students with a concentration in Public Health Data Science. It is a continuation of an earlier course (e.g., BIOS 600 or BIOS 500) that introduces probability theory, variable distributions, estimation, and hypothesis testing. The goals of the course are to advance students' understanding of (i) the statistical concepts involved in linear modeling, including exploratory data analysis, parameter estimation, and hypothesis testing; (ii) how a statistical model is motivated by substantive research questions; (iii) how the research data are related to the research questions; (iv) the analytical skills and corresponding software tools (primarily SAS) needed to conduct statistical analyses; and (v) the communication skills, both written and verbal needed to explain statistical analyses to scientific collaborators and correctly convey the results of statistical analyses.

Course Format

The course format is centered on weekly lectures in class. The lectures will be supplemented with an optional lab session run by the TA. That session is primarily for getting help with homework or understanding concepts.

Required Readings

Required:

- Kutner, D., Nachtsheim, C., and Neter, J. (2004). *Applied Linear Regression Models*. 4e. McGraw-Hill/Irwin. ISBN-13: 978-0073014661(not on reserve)

OR:

- Kleinbaum, D.G., Kupper, L.L., Nizam, A., and Rosenberg, E.S. (2013): *Applied Regression Analysis and Other Multivariable Methods*, 5th Edition. Brooks Cole. ISBN-13: 978-1285051086 (also on reserve)

Optional References (these should all be on reserve in HSL):

Basic statistics:

- Moore, D. S. and McCabe, G. P. (2003). *Introduction to the Practice of Statistics*. 4ed. Freeman.

Regression:

- Kutner, D., Nachtsheim, C., Neter, J., and Li, W. (2005). *Applied Linear Statistical Models*. 5e. McGraw-Hill/Irwin.

SAS:

- Delwiche, L. D. and Slaughter S. J. (2019). *The Little SAS Book*. 6ed. SAS Institute.
- Freund, R. J. and Littell, R. C. (2000). *SAS System for Regression*. 3ed. SAS Institute.

Other Resources:

- SAS acquisition pdfs: "Options for Running SAS" / "2021 How To SAS Academic Hub Students" / "2021 new registration-sas-studio"
- The SAS documentation
- UCLA Statistical consulting's online SAS tutorials <https://stats.idre.ucla.edu/sas/>
- The Odum institute, on the 2nd floor of Davis library

Course-at-a-Glance

The instructor reserves the right to make changes to the syllabus, including topics, readings, assignments, and due dates. Any changes will be announced as early as possible. For session-by-session course schedule details, please see below, the Sakai course site.

Date/ Session Number	Topic	Assignment Due
Week 1 Tues 1/11	1. Introduction & Syllabus	
Thurs 1/13	2. Review of elementary SAS skills	
Week 2 Tues 1/18	3. Review of elementary statistics concepts	
Thurs 1/20	4. Simple regression – estimation	
Week 3 Tues 1/25	5. Simple regression – inference	Quiz 1
Thurs 1/27	6. Goals for regression models	Homework 1
Week 4 Tues 2/1	7. Regression model diagnostics	Quiz 2
Thurs 2/3	8. Regression model diagnostics	Homework 2
Week 5 Tues 2/8	9. Goodness of fit	Quiz 3
Thurs 2/10	10. Polynomial regression	Homework 3
Week 6 Tues 2/15	11. Multiple regression	Quiz 4
Thurs 2/17	12. Interactions	Homework 4
Week 7 Tues 2/22	13. Correlated variables (multicollinearity)	Quiz 5
Thurs 2/24	14. Correlated variables (endogeneity)	Homework 5
Week 8 Tues 3/1	15. Inference with correlated variables	Quiz 6
Thurs 3/3	16. Coding strategies for categorical (& ordinal) variables & ANCOVA	Homework 6
Week 9 Tues 3/8	17. One-way ANOVA (review for midterm on Wednesday)	Quiz 7
Thurs 3/10	18. Midterm Exam	

Date/ Session Number	Topic	Assignment Due
Week 10 Tues 3/15	Spring Break!	
Thurs 3/17	Spring Break!	
Week 11 Tues 3/22	19. Variable importance & Exam review	
Thurs 3/24	20. Multiple comparisons	Homework 7
Week 12 Tues 3/29	21. Two-way ANOVA & blocking	Quiz 8
Thurs 3/31	22. Variable selection I	
Week 13 Tues 4/5	23. Variable selection II	Quiz 9
Thurs 4/7	24. Binomial distribution & Maximum Likelihood	
Week 14 Tues 4/12	25. Logistic regression – estimation	Quiz 10
Thurs 4/14	26. Logistic regression – inference	
Week 15 Tues 4/19	27. Poisson regression & Other types of statistical models	Quiz 11
Thurs 4/21	28. (buffer)	Homework 8 (optional / ExCrd)
Week 16 Tues 4/26	29. Review	
Finals Tues 5/3, noon	Final Exam	

Course Assignments and Assessments

This course will include the following graded assignments that contribute to your final grade in the course. For assignment descriptions and assignment grading rubrics, please see below.

1. Quizzes (25%)

There will be an 'initial quiz' at the beginning of Tuesday's class every week. **All quizzes will be administered within Sakai, be sure to be signed in to Sakai by 12:30pm, sharp—the quizzes are timed and will disappear at 12:35pm.** The quizzes are intended to be short and simple, and assess basic factual knowledge. Quizzes will have a small number of questions (max: 5), be primarily TRUE/FALSE, multiple choice or matching, etc., and worth 10 points each. The final quiz grade will be computed after dropping your lowest individual quiz score. This means it is possible to have missed a class without penalty. My intention is that it's easy to get close to full credit if you had prepared for class. However, I don't seem to be very good at writing questions student find easy. At the end of the semester, I typically (but reserve the right not to) adjust the final scores (e.g., if all scores are low, I might normalize the totals relative to the class' highest score, or I might drop a question that no one got, etc.). Your final quiz score will almost certainly be similar to your final homework, and exam scores.

2. Homework Assignments (25%)

Homework will be assigned as close to every week as possible, and due at noon, a half hour before class on Thursdays. The homeworks are intended to develop your skills at analyzing data and using SAS, and/or to reinforce important concepts. A typical homework will consist of fitting a regression model in SAS using a provided dataset and interpreting it. The homeworks will be worth 10 points each. You will need to upload to Sakai two things: (1) commented SAS code and (2) an analysis results document. If the problem is done and everything is right, you will get full credit; points will be deducted for mistakes, incorrect conclusions, etc. The final homework grade will be computed after dropping your lowest individual homework score. This means it is possible to have missed a class (or come to class without having done the homework) without penalty. I also typically have an extra credit homework at the end. Adjustments may be made at the end of the semester, but this is less common / aggressive than for the quizzes.

3. Mid-Term Exam (25%)

The exam will be short answer. They will primarily test understanding of important concepts.

4. Final Exam (25%)

As with the midterm, the final will be short answer and intended to assess conceptual understanding. The final exam will be cumulative, but will emphasize the material from the latter half of the semester more than the first half.

Graded Assignments	Percentage of Final Course Grade
1. Quizzes	25
2. Homework	25
3. Midterm Exam	25
4. Final Exam	25
TOTAL	100

Course Grading Scale(s)

Final course grades will be determined using the following [UNC Graduate School grading scale](#). The relative weight of each course component is shown in the Graded Assignments section.

- **H**—High Pass (93-100): Clear excellence
- **P**—Pass (80-92): Entirely satisfactory graduate work
- **L**—Low Pass (70-79): Inadequate graduate work
- **F**—Fail (0-69)

Final course grades will be determined using the following [UNC Undergraduate grading system](#).

A (90-100): Mastery of course content at the highest level of attainment that can reasonably be expected of students at a given stage of development. The A grade states clearly that the students have shown such outstanding promise in the aspect of the discipline under study that he/she may be strongly encouraged to continue.

B (80-89): Strong performance demonstrating a high level of attainment for a student at a given stage of development. The B grade states that the student has shown solid promise in the aspect of the discipline under study.

C (70-79): A totally acceptable performance demonstrating an adequate level of attainment for a student at a given stage of development. The C grade states that, while not yet showing unusual promise, the student may continue to study in the discipline with reasonable hope of intellectual development.

D (60-69): A marginal performance in the required exercises demonstrating a minimal passing level of attainment. A student has given no evidence of prospective growth in the discipline; an accumulation of D grades should be taken to mean that the student would be well advised not to continue in the academic field.

F (0-59): For whatever reason, an unacceptable performance. The F grade indicates that the student's performance in the required exercises has revealed almost no understanding of the course content. A grade of F should warrant an advisor's questioning whether the student may suitably register for further study in the discipline before remedial work is undertaken.

Map of Competencies to Learning Objectives and Assessment Assignments

Below you will see the program competency(ies) you will develop in this course, the learning objectives that comprise the competency, and the assignment(s) in which you will practice demonstrating each competency.

Competency:

DAT05. Provide tools that facilitate the expansion of complex statistics and methods to public health contexts traditionally reticent to move away from more traditional approaches, thereby extending the reach of quantitative and methodological innovations in public health.

Learning Objectives that comprise the competency:

- L1. Become familiar with statistical concepts that are important in understanding linear models, including exploratory data analysis, parameter estimation, and hypothesis testing
- L2. Understand how the development of a statistical model is motivated by substantive research questions (and specifically, to be able to connect research ideas to a concrete multiple regression model)
- L3. Develop the ability to use statistical concepts to help understand how research data are related to a research question
- L4. Develop data analytical skills including use of statistical software (primarily SAS) to conduct statistical analyses
- L5. Develop the ability to talk about statistics in simple, short, and clear ways
- L6. Develop writing skills needed to communicate the results of data analyses

Assessment Assignment for evidence of student attainment of competency:

The homeworks will demonstrate students' ability to take a dataset and a question, and conduct an analysis and interpret the results. The midterm and final exams require students to explain aspects of statistical analyses in simple, short, and clear ways.

Expectations, Policies, and Resources

Accessibility at UNC Chapel Hill

The University of North Carolina at Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability or pregnancy complications resulting in barriers to fully accessing University courses, programs and activities. Accommodations are determined through the Office of Accessibility Resources and Service (ARS) for individuals with documented qualifying disabilities in accordance with applicable state and federal laws. See the [ARS Website](#) for contact information or email ars@unc.edu.

Attendance/ Participation

Your attendance and active participation are an integral part of your learning experience in this course. If you are unavoidably absent, please notify the course instructor (and Teaching Assistant if one is assigned). No right or privilege exists that permits a student to be absent from any class meetings, except for these University Approved Absences:

1. Authorized University activities
2. Disability/religious observance/pregnancy, as required by law and approved by [Accessibility Resources and Service](#) and/or the [Equal Opportunity and Compliance Office](#).
3. Significant health condition and/or personal/family emergency as approved by the [Office of the Dean of Students](#), [Gender Violence Service Coordinators](#), and/or the [Equal Opportunity and Compliance Office](#).

Community Standards in Our Course and Mask Use.

This semester, while we are still in the midst of a global pandemic, all enrolled students are required to wear a mask covering your mouth and nose at all times in our classroom. This requirement is to protect our educational community — your classmates and me – as we learn together. If you choose not to wear a mask, or wear it improperly, I will ask you to leave immediately, and I will submit a report to the [Office of Student Conduct](#). At that point you will be disenrolled from this course for the protection of our educational community. Students who have an authorized accommodation from Accessibility Resources and Service have an exception. For additional information, see [Carolina Together](#).

Counseling and Psychological Services at UNC Chapel Hill

CAPS is strongly committed to addressing the mental health needs of a diverse student body through timely access to consultation and connection to clinically appropriate services, whether for short or long-term needs. Go to the [CAPS website](#), call them at 919-966-3658, or visit their facilities on the third floor of the Campus Health Services building for a walk-in evaluation to learn more.

Honor Code

As a student at UNC Chapel Hill, you are bound by the [university's Honor Code](#), through which UNC maintains standards of academic excellence and community values. It is your responsibility to learn about and abide by the code. To ensure an effective Honor System at UNC, in this course students are expected to:

- Conduct all academic work within the letter and spirit of the Honor Code, which prohibits the giving or receiving of unauthorized aid in all academic processes.
- The quizzes will be completed via Sakai, but are intended to be closed book / closed notes. Other files, browser tabs, etc., should be closed during the quizzes.
- Students may discuss homework assignments (approach, code, etc.) with each other or the TA but the submitted work should entirely their own.
- Exams must be completed completely independently without communicating with other students, tutors, or anyone else about any material related to the test questions.

If you have any questions about your rights and responsibilities, consult the [Office of Student Conduct](#) or review the following resources: [Honor System](#); [Honor System module](#); [UNC Library's plagiarism tutorial](#); [UNC Writing Center's handout on plagiarism](#).

Inclusive Excellence

We are committed to expanding diversity and inclusiveness across the School — among faculty, staff, students, on advisory groups, and in our curricula, leadership, policies and practices. We measure diversity and inclusion not only in numbers, but also by the extent to which students, alumni, faculty, and staff members perceive the School's environment as welcoming, valuing all individuals, and supporting their development.

For more information about how we are practicing inclusive excellence at the Gillings School, visit the following webpages: [Inclusive Excellence](#), [Inclusive Excellence Action Plan](#), [Minority Health Conference](#), and [National Health Equity Research Webcast](#).

Additional campus resources include: the [LGBTQ Center](#); [Non-Discrimination Policies at UNC Chapel Hill](#); [Ombuds](#); and [Prohibited Discrimination, Harassment, and Related Misconduct at UNC Chapel Hill](#).

In this class, we practice the Gillings School's commitment to inclusion, diversity, anti-racism and equity in the following ways.

- Develop classroom participation approaches that acknowledge the diversity of ways of contributing in the classroom and foster participation and engagement of *all* students.
- Structure assessment approaches that acknowledge different methods for acquiring knowledge and demonstrating proficiency.
- Encourage and solicit feedback from students to continually improve inclusive practices.
- Treat all members of the Gillings community (students, faculty, and staff) as human persons of equal worth who deserve dignity and respect, even in moments of conflict and disagreement.
- Contribute to creating a welcoming and inclusive classroom environment, where all are able to learn and grow from one another.
- Acknowledge and respect the diversity of experiences that others bring to the classroom and the ways in which this richness enhances everyone's learning
- Strive to maintain a spirit of curiosity and generosity, particularly in the face of new and/or seemingly contradictory information and perspectives Encourage and solicit feedback from students to continually improve inclusive practices.

Land Acknowledgement

Please read The Gillings School's [Land Acknowledgement](#).

Student Feedback and Equity Concerns

The Gillings School has in place a [mechanism for students to provide feedback](#), including specifically equity concerns and bias-related issues. You can use this form to describe feedback, both positive and negative, about anything including issues related to your experience as a student at Gillings, administrative processes, and classroom activities. This form will also allow you to specifically describe incidents in which racial or other equity-related bias, or microaggressions, occurred. You may submit this form anonymously. However, for us to follow up and provide the necessary support, we encourage you to include your contact information. For further information, please visit the [Student Feedback and Equity Concerns FAQ](#).

Please note that this form does not take the place of any University process or policy. If you would like to report an incident under the University's policy on [Prohibited Discrimination, Harassment, and Related Misconduct including Sexual and Gender Based Harassment, Sexual Violence, Interpersonal Violence, and Stalking](#), please visit [Safe At UNC](#) or the [Equal Opportunity and Compliance Office](#) (EOC) for additional information, including resources, contact, and reporting options.

Technical support

The best way to help prevent technical issues from causing problems for assignments and quizzes is to submit them at least 24 hours before they are due. Your instructor cannot resolve technical issues, but it's important to notify them if you are experiencing issues. If you have problems submitting an assignment or taking a quiz in Sakai, immediately do the following:

1. Contact the UNC Information Technology Services (ITS) department with the time you attempted to do your course action and what the course action was.
2. Email your instructor with the information you sent to ITS and what time you sent the information.

The ITS department provides technical support 24-hours per day, seven days per week. If you need computer help, please contact the ITS Help Desk by phone at +1-919-962-HELP (4357), or by [online help request](#), or by [UNC Live Chat](#).

Title IX at UNC Chapel Hill

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitations, or stalking is encouraged to seek resources on campus or in the community. Please contact the Director of Title IX Compliance / Title IX Coordinator ([Adrienne Allison](#)), [Report and Response Coordinators in the Equal Opportunity and Compliance Office](#), Counseling and Psychological Services (confidential), or the [Gender Violence Services Coordinators](#) (confidential) to discuss your specific needs. Additional resources are available at the ["Safe at UNC" website](#).

Assignment Grading Rubrics

Quizzes (25%)

Criteria	Fully Met	Partially Met	Not met
5 Factual Questions (2 points each, 10 points total)	Answer correct (2 points)	If questions have multiple parts (e.g., select all that apply), and the answer is partly correct. (>0 & <2 points)	No answer, or incorrect answer (0 points)

Homework Assignments (25%)

Criteria	Met	Partially Met	Not Met
On time (1 point)	Sakai says it is not late (1 point)	n/a	Sakai says it is late (0 points)
SAS code (3 points)	SAS code is uploaded with your submission. There are comments explaining what you're doing, and you looked at plots and descriptive statistics for your data first (3 points)	No comments in code (2 points) Didn't look at data (2 points) Neither (1 point)	There is no SAS code with your submission (0 points)
Write-up (6 points)	Answer is clear, complete, and correct (-0 points, per answer)	Answer is somewhat unclear, incomplete or partially correct (-.5 point, per answer)	Answer unclear, or incorrect (-1 point, per answer)

Mid-Term & Final Exams (25% each)

Criteria	Fully Met	Partially Met	Not Met
8-10 short answer questions (10 - 20 points each)	Answer is completely correct (10 / 15 / 20 points) Answer is nearly completely correct (9 / 14 / 19 points)	Answer is relevant and has some correct elements (8 / 13 / 18 points) Answer is less relevant and has fewer correct elements (7 / 12 / 17 points)	Answer is incoherent or completely incorrect (6 / 11 / 16 points) No answer (0 points)